The role of socio-economic status and energy-density in Australian women of child-bearing age. — Source link

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The role of socioeconomic status and energy-density in Australian women of child-bearing age

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The role of socioeconomic status and energy-density in Australian women of child-bearing age

Abstract

Introduction

Optimal diet is imperative in preparing women for pregnancy and this may be influenced by socioeconomic status (SES). This research aims to investigate the role of SES on the dietary energy-density (ED) in Australian women of pre-conception age.

Methods

A secondary analysis of the Australian National Nutrition and Physical Activity Survey 2011-12 for females aged 18-39 years (n=1617) was conducted. Dietary intake was assessed by 24-hr recalls and dietary ED by dietary energy/weight in grams (kJ/g). ED was further categorised as ED of foods and beverages separately. SES was assessed by three variables: Socio-Economic Indexes for Areas (SEIFA), developed by the Australian Bureau of Statistics; income decile and; level of education. Linear mixed model regressions were used to identify associations between ED and SES.

Results

The median ED for food, beverages and combined food and beverages was 9.38kJ/g, 1.02kJ/g and 7.11kJ/g, respectively. No significant variation was explained by SES variables when analysing combined ED in the adjusted model or ED from foods. Income decile reduced ED of beverages, although with little effect (coef: -0.04, p=0.002). Significant confounders included inactivity which increased ED in both combined ED and ED foods (coef: 0.51, p=0.001 and coef: 0.78, p<0.001).

Conclusion

SES explained little variation in dietary ED in women of childbearing age. A large proportion of women had high energy-dense diets regardless of their SES. These findings suggest that a large proportion of women, that may become pregnant, have diets that exceed the international recommendations for dietary energy density.

Introduction

Almost half of pregnancies worldwide were unintended during 2010-2014 [1]. This highlights the importance of women achieving and maintaining optimal health in childbearing years regardless of pregnancy intentions [1, 2]. The nutritional status of women prior to and during the period of conception is crucial for foetal development and birth outcomes [3-5], as a developing foetus will depend on the mother's stored nutrients throughout pregnancy [6]. Deleterious preconception behaviours including sub-optimal nutrition and maternal obesity can negatively influence the quality of a woman's ovum, the subsequent foetal development and birth outcomes [1, 6, 7]. Recent research suggests that sub-optimal maternal nutritional status can lead to the reprogramming of foetal tissues, predisposing the infant to chronic disease later in adulthood [3, 5-10].

Inadequate maternal nutrition may be influenced by the energy density (ED) of the diet. Foods that are more energy-dense tend to be of poor quality, lack important nutrients for pregnancy and can lead to overweight or obesity [11-13]. ED can be defined as the energy content of the food in kilojoules (kJ) per amount of food in grams (g) (ED = kJ/g) [11, 14]. Foods with a lower ED are typically nutrient-dense, particularly core foods outlined by the Australian Dietary Guidelines (ADG) such as fruit, vegetables and wholegrain cereals [12, 13, 15]. Lean meat and alternatives and dairy foods and equivalents are also described as core foods by the ADG. Consumption of lower energy-dense foods is associated with decreased risk of overweight and abdominal obesity [11, 13]. In contrast, energy-dense foods tend to be nutrient-poor and high in saturated fat, salt and added or refined sugar, also referred to as discretionary foods by the ADG [12, 13, 15]. The World Cancer Research Fund (WCRF) has recommended that average dietary ED (excluding beverages) be lowered towards 5.23kJ/g (125kcal/100g) to prevent weight gain [16].

Globally, the prevalence of obesity has almost tripled since 1975 [17]. The prevalence of overweight and obesity has increased in Australia by almost 10% in 20 years, with two-thirds of Australians classed as being overweight or obese in 2014-15 [18]. Overweight and obesity increases the risk of health conditions such as diabetes mellitus, hypertension and cardiovascular disease and additionally affects female reproductive health [1, 9, 19, 20]. Obesity is associated with several reproductive disorders including anovulation, infertility, gestational diabetes mellitus, preeclampsia, preterm delivery, still-birth delivery and macrosomia in the infant [1, 9, 19, 20]. Evidence suggests that maternal adiposity and weight gain during pregnancy may lead to an intergenerational cycle of obesity, causing increased adiposity and body mass index (BMI) in the offspring [7, 21].

Obesity is more likely to occur in women of lower SES within developed nations [22]. People belonging to low SES groups are at greater risk of poor health, experience higher rates of chronic illness, disability and death and have a lower life expectancy than higher SES groups [23, 24]. An inverse association exists between obesity status and SES within developed nations, with a stronger association among females than males [22, 24, 25]. Evidence suggests this inverse association may be partly explained by higher rates of unhealthy behaviours among lower SES groups, including increased rates of smoking, sedentary behaviour and obesogenic diets [22, 26]. Consequently, women of low SES may experience higher rates of nutrient deficiencies and poor birth outcomes [10, 27].

The relationship between SES and dietary intake has been explored in young Australian adults, assessing both the ED and diet quality [11]. Young Australian adults were found to have poor quality diets that are high in energy-dense foods, highlighting an inverse association between dietary ED and SES [11]. The association between SES, dietary intake and health-related factors has been studied in pregnant Austrian women, with findings highlighting that dietary intake and BMI of pregnant women is strongly predicted by education [5]. Food and nutrient intakes have been investigated in young Irish women of differing SES to identify associations of poorer nutrient intakes among socially disadvantaged women. They found significant nutrient and food group deficits among women of low SES [28]. The relationship between income, SES and dietary intake has previously been investigated in Australia using national data on males and females aged 18 years and over. Findings from the study identified that income influences the variety of the diet, with men and women of low income households having less variety than higher income households [29].

Socioeconomic differences in dietary ED have not been investigated in relation to the preparedness of Australian women for pregnancy. Therefore, this research aims to investigate the role of SES on the dietary ED of Australian women in their childbearing years.

Methods

Study Participants

This analysis uses data from the Australian Bureau of Statistics' Australian Health Survey (AHS) 2011-2013. The AHS was designed to provide a cross-sectional multi-stage area sample, representative of 97% of the Australian population. Detailed information regarding participant recruitment, data collection and additional measures are available elsewhere [30]. Females aged 18-39 years were selected for inclusion in this study to represent the age range of approximately 95% of women who gave birth in the year 2016 [31]. Preconception was defined as any woman within the specified ages (18-39 years) who was not pregnant, menopausal, post-menopausal or premenarchal. Women whom were breastfeeding and at preconception stages were included.

Demographics describing socioeconomic status

The ABS Socio-Economic Indexes for Area (SEIFA) summarises SES factors by using social and economic information including education and occupation from the five-yearly Census. Each geographical area was scored according to SES advantage and disadvantage in comparison to other areas in Australia [(32)]. The data from the AHS was recorded into SEIFA quintiles, from lowest 20% (first quintile) to the highest 20% (fifth quintile). Income deciles were also included, as was the highest level of non-school qualification. Non-school qualifications ranged from postgraduate degree or graduate diploma through to no non-school qualifications.

Study Design

This study uses data collected as a 24-hour dietary recall, conducted as part of the Australian National Nutrition and Physical Activity Survey (NNPAS) component of the Australian Health Survey in 2011-13 [(30)]. The NNPAS collected information regarding food, beverage and supplement intake in the 24-hours of the day prior to the interview. Information was collected using the Automated Multiple Pass Method. The initial interview was conducted using Computer Assisted Personal Interview software. Where possible, a second 24-hour dietary recall was conducted via telephone interview ≥8 days following the initial interview using Computer Assisted Telephone Interview [(33)]. Only data from the initial day was used in the analysis due to a lower participation rate for the second day (64%) [(30)]. AUSNUT 2011-13 food composition database developed by Food Standards Australia and New Zealand was used to analyse the nutritional composition of foods and to reflect the Australian food supply [(34)].

Dietary Energy-Density

ED was calculated using three methods: (1) considered food only (ED_{food}), (2) considered beverages only (ED_{bev}), including water, and (3) combined food and beverages ($ED_{food+bev}$). ED was calculated by dividing the energy content of foods and/or beverages in kilojoules (kJ), by the amount consumed in grams (g), i.e. ED=kJ/g. Beverages were analysed separately as the ED of beverages is relatively low in comparison to food, which can obscure the relationship between exposure to energy-dense foods and health outcomes [(11, 35)] Food and beverages can be consumed in combination, for example cereal with the addition of milk or sugar added to tea. Food combination codes and meal occasion codes were used to identify these items and classify them as foods or beverages accordingly (see Supplementary Figure 1). Meal codes were used to identify ambiguous food and beverages, i.e. meal replacements and supplementary and medical foods. The aforementioned methods for measuring ED have been described in further detail elsewhere [(14)], and adapted for compatibility with AUSNUT 2011-13 food composition database. The mean ED_{food} was compared with the WCRF guidelines for average dietary ED (excluding beverages) of 5.23 kJ/g [(11, 16, 36)]. The WCRF defines high energy-dense foods as those with an ED of more than 9.4-11.5kJ/g (225-275kcal/100g) [(16)].

Statistical Analysis

Participant demographic information was reported using descriptive statistics. Normally distributed data were presented as mean±standard deviation (SD) and non-normal data presented as interquartile range (IQR). Linear mixed model regressions were used to investigate the association between SES variables, ED (food, beverages and combined food and beverages), overall energy intake and overall weight of food. The model was adjusted to account for potential confounders (such as BMI, smoking status, and country of birth) and included based on a p value of ≤0.2 in a multivariate model with SEIFA, education and income if the inclusion of the confounder also improved the model fit ($p<0.1$). Data were analysed using Stata/IC Version 15.1 (StataCorp. 2017. Stata Statistical Software: StataCorp LLC, College Station, TX, USA).

Ethics Approval

The Australian Bureau of Statistics received ethics approval to conduct the 2011-12 interview components of the NNPAS from the Census and Statistics Act of 1905 [(30)]. Ethical approval to perform a secondary data analysis on ABS Confidentialised Unit Record Files was from the **[removed for peer review]** (Approval number H-2015-0216).

Results

Of the 6,451 females in the NNPAS data set, those <18 years (n=1,345) and >39 years (n=3,341) were excluded. The following women were also excluded from the analysis: have never menstruated (n=6), currently pregnant (n=111), currently experiencing menopause (n=7), and post-menopause (n=3). A total of 1,638 women aged 18-39 years which included 102 breastfeeding women, were used in this analysis.

Characteristics of included women are available in Table 1. Women were predominantly at the lower end of the overweight BMI category (25-29.9kg/m^2), with a mean BMI of 26.0±6.1 kg/m^2. The average waist circumference (WC) of 84.2±14.6cm was >80cm, a marker of increased risk of chronic disease for women [(37)]. A decreasing trend was seen in median waist circumference across SEIFA quintiles.

The most frequently reported income bracket was $AUD 1,630 – $2,492 per week (n=369, 22.5%). In the first- and second- income deciles, approximately half the participants were single parent families with children. Most participants (84%) reported their highest level of schooling at year 11 or 12, with almost 70% reporting a non-school qualification. [(38)].

Table 1: Physical characteristics, education, income and non-school qualifications of Australian women of childbearing age across the SEIFA quintiles (n=1638)

SEIFA Quintile	First		Second		Third		Fourth		Fifth		Total	
Characteristics	n	%	n	%	n	%	n	%	n	%	n	%
Females	325	19.8	307	18.7	337	20.6	278	17.0	391	23.9	1,638	100
18 years	8	0.5	11	0.7	10	0.6	5	0.3	12	0.7	46	2.8
19-39 years	317	19.4	296	18.1	327	20.0	273	16.7	379	23.1	1,592	97.2
Married	117	7.1	130	7.9	172	10.5	136	8.3	191	11.7	746	45.4
Physical Measures	**Median (IQR)**		**Median (IQR)**		**Median (IQR)**		**Median (IQR)**		**Median (IQR)**		**Median (IQR)**	
Height n=1,438	163.0 (158.2-167.0)		165.5 (161.4-169.7)		164.0 (159.5-169.2)		164.0 (159.3-168.5)		165 (161.0-169.3)		164.5 (160.0-169.0)	
Weight n=1,421	68.3 (58.7-84.3)		69.4 (59.2-83.5)		65.7 (58.7-77.0)		64.9 (57.1-76.0)		64.4 (56.8-76.2)		66.2 (58.0-78.9)	
BMI (kg/m^2) n=1,416	25.5 (22.5-31.5)		24.9 (21.5-30.8)		24.2 (21.7-28.6)		23.9 (21.4-27.7)		23.6 (20.9-27.6)		24.2 (21.5-29.2)	
WC (cm) n=1407	84.0 (75.6-98.0)		84.0 (74.5-95.5)		82.0 (73.0-92.0)		80.0 (73.0-89.8)		79 (72.0-89.3)		81 (73.4-93.0)	
BMI Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Underweight	11	0.8	9	0.6	7	0.5	10	0.7	13	0.9	50	3.5
Normal	120	8.4	127	8.8	158	11.0	130	9.1	208	14.5	743	51.7
Overweight	63	4.4	61	4.3	75	5.2	55	3.8	70	4.9	324	22.6
Obese	86	6.0	72	5.0	58	4.0	42	2.9	61	4.3	319	22.2
Female Life Stage												
Breastfeeding	16	1.0	25	1.5	23	1.4	18	1.1	20	1.2	102	6.2
Preconception	309	18.9	282	17.2	314	19.2	260	15.9	371	22.7	1,536	93.8
Household income (weekly)												
≤$561	98	6.0	48	2.9	39	2.4	18	1.1	22	1.3	225	13.7
$562 - $998	67	4.1	71	4.3	58	3.5	33	2.0	31	1.9	260	15.9
$999 - $1,629	52	3.2	55	3.4	74	4.5	60	3.7	45	2.8	286	17.5
1,630 – $2,492	55	3.4	67	4.1	71	4.3	64	3.9	112	6.8	369	22.5
≥$2,493	27	1.7	37	2.3	56	3.4	73	4.5	133	8.1	326	19.9
Not stated	3	0.2	9	0.6	6	0.4	8	0.5	8	0.5	34	2.1
Not known	23	1.4	20	1.2	33	2.0	22	1.3	40	2.4	138	8.4
Highest level of schooling												
Year 8 or below[a]	4	0.2	4	0.2	5	0.3	2	0.1	1	0.1	16	1.0
Year 9 or 10	78	4.8	60	3.7	45	2.8	30	1.8	34	2.1	247	15.1
Year 11 or 12	243	14.8	243	14.8	287	17.5	246	15.0	356	21.7	1,375	83.9
Highest qualification.												
≤High school qualification	135	8.3	106	6.5	110	6.8	56	3.4	95	5.8	502	30.9
Certificate I-IV[b]	95	5.8	96	5.9	74	4.6	59	3.6	73	4.5	397	24.4
Diploma/Adv. Diploma	26	1.6	31	1.9	38	2.3	41	2.5	36	2.2	172	10.6
Bachelor degree	53	3.3	59	3.6	86	5.3	80	4.9	135	8.3	413	25.4
Postgraduate, etc.	14	0.9	14	0.9	28	1.7	38	2.3	49	3.0	143	8.8
Labour force status												
Employed	195	11.9	204	12.5	253	15.5	222	13.6	328	20.0	1,202	73.4
Unemployed	19	1.2	13	0.8	11	0.7	10	0.6	15	0.9	68	4.2
Not in labour force	111	6.8	90	5.5	73	4.5	46	2.8	48	2.9	368	22.5

[a] Includes never attended school; [b] Includes certificate not further defined.
SEIFA, Socio-Economic Indexes for Areas. BMI, Body Mass Index. WC, Waist Circumference.
SEIFA quintiles, first (lowest) to fifth (highest).

Energy-Density results

[Insert figure 1a-c here]

Figure 1a-c. Frequency of mean $ED_{food+bev}$, ED_{food}, and ED_{bev} reportedly consumed by Australian childbearing women.

[insert figure 2a-c here]

Figure 2a-c. Differences in mean $ED_{food+bev}$, ED_{food}, and ED_{bev} across the SEIFA quintiles.

The median ED_{food}, ED_{bev} and $ED_{food+bev}$ for all participants was 9.38 kJ/g (IQR: 7.63-11.09), 1.02kJ/g (0.64-1.44) and 7.11kJ/g (5.73-8.39), respectively (see Figure 1a-c). Almost all women (94.8%) were consuming diets with an average ED_{food} that exceeded the WCRF recommendations of 5.23kJ. The first (lowest) quintile had the highest ED_{food} (9.75kJ/g (7.80-11.59)), while the second SEIFA quintile had the highest ED_{bev} (1.09kJ/g (0.66-1.44)). The two lowest SEIFA quintiles had the highest $ED_{food+bev}$, with a median value of 7.23kJ/g (see Figure 2a-c).

SEIFA, income and education did not explain variance in either the unadjusted or adjusted model of $ED_{food+bev}$. Included in the adjusted model was marital status, BMI, basal metabolic rate (BMR), country of birth and whether activity level was sufficient for good health. Significant confounders included being born in a non-English speaking country, or not married and were more likely to have a reduced $ED_{food+bev}$ (coefficient: -0.57, p<0.001 and coef: -0.22, p=0.045 respectively), whereas those that were inactive were more likely to have a more energy-dense diet (coef: 0.51, p=0.001).

Similar results were found for ED_{food}, again with SEIFA, income and education showing little explanation for the variation in the unadjusted and adjusted regressions. Confounders such as BMI and age, although significant (p=0.008 and p=0.031 respectively) had little effect on ED_{food} (coef: -0.03 and 0.03 respectively). Inactivity, activity levels insufficient for good health and eating much less than usual were all shown to increase ED_{food} (coef: 0.78, p<0.001; coef: 0.40, p=0.015 and coef: 0.54, p=0.003 respectively). Alternately, a non-English speaking country of birth decreased ED_{food} (coef: -0.90, p<0.001) as did the ED_{food} in those that had never smoked (coef: -0.452, p=0.028).

Insignificant results were found for SEIFA and education in the unadjusted ED_{bev} model (coef: -0.00, p=0.984, coef: 0.01, p=0.616 respectively), with little significant effect explained by income (coef: -0.04, p=0.002). Similarly, in the adjusted model, income and age had minimal effect (and coef: -0.02, p=0.010 respectively) and income was no longer significant (coef: -0.03, p=0.068).

Education, but not SEIFA or income was significant in the unadjusted model for total energy intake with lower levels of education consuming less total energy (coef: -93.80, p=0.014). In the adjusted model, education was no longer significant (p=0.245). Confounders having greater effect were eating much more than usual (coef: 620.80, p=0.26) and eating much less than usual (-927.36, p<0.001). Every increase in BMI unit decreased energy intake by 56kJ (coef: -55.67, p<0.001). Energy intake increased in those who were inactive (coef: 818.17, p=0.001) and insufficiently active (371.70, p=0.048).

Initial associations were found with education and income and the total weight of dietary intake, with lower non-school education reducing total weight of intake (coef: -46.84, p=0.002) and income increasing it (coef: 43.95, p<0.001). Neither remained in the adjusted model. Significant confounders which increased the weight of dietary intake included eating much more than usual (coef: 216.43, p=0.046), age (coef: 21.19, p<0.001) and being taller (coef: 15.96, p=0.001). Reduced weight of intake was associated with never smoking (coef: -333.55, P<0.001), inactivity (coef: -400.21, p<0.001), insufficient activity (coef: -217.27, p=0.003), and having children (couple with children, coef: -210.40, p=0.046; sole parent, coef: -486.18, p<0.001). High fat foods, concentrated beverages and some commercial or takeaway foods contributed to high ED, energy content and weight analysis (see Supplementary Figure 2).

Discussion

Overall, the dietary intakes of a from this sample of Australian childbearing aged women were of poor quality and high ED, with large disparity from the ADG. SEIFA, income and education showed little effect on ED in any model, with various lifestyle confounders having greater effects. Inactivity and activity levels insufficient for good health, smoking, BMI, country of birth, marital status, whether the woman already had children and eating more or less than usual had greater effect on the ED of the diet reported. These findings suggest that Australian women of childbearing age may not be eating diets of optimum energy density and that lifestyle factors are having a greater effect than SES.

Significant inverse associations have been found between SES and dietary ED in previous research, which differs from the findings here [11, 25, 39, 40]. Higher levels of education and income were inversely associated with dietary ED in an American study of male and female participants [41]. ED was found to be positively associated with living below the poverty line among a representative sample of the adult population in Luxembourg (β=0.125) [42]. Australian women from lower SES areas have significantly higher dietary ED than those from higher SES groups [11]. Grech, Rangan and Farinelli found a difference of +0.52kJ/g between the highest and lowest SEIFA quintiles in an Australian study of males and females aged 18-34 years [11]. Further, participants with a university education (6.85kJ/g) had the lowest dietary ED compared to those with no tertiary education (7.53kJ/g) [11]. Small increases in ED can contribute to total energy intake, therefore disturbing energy balance in favour of weight gain [11]. Increases in ED as small as 0.2kJ/g can significantly increase the populations energy intake, subsequently leading to weight gain [36]. A systematic review found that low dietary ED decreased body weight and prevented weight regain in obese adults [43]. In comparison to higher energy-dense foods, lower energy-dense foods were found to have similar to higher satiety effects following consumption, with reduced energy intake [43].

Our study found significant decreases in ED in people who were born overseas, compared to those born in Australia or other main English-speaking countries, explaining moderate variation in $ED_{food+bev}$ and ED_{food} (coefficient: -0.57, $p<0.001$ and coef: -0.90, $p<0.001$ respectively). An Australian study found a significant inverse association ($p<0.0001$) between those born in non-English speaking countries (6.77kJ/g) compared to those born in Australia and other English speaking countries (7.36kJ/g) [11]. Our research found that the ED_{food} of those who had never smoked was lower (coef: -0.452). This relationship between dietary ED and smoking is supported by recent research from the United States, using a national representative sample of adults over 18 years [44]. MacLean, Cowan and Vernarelli found that daily and non-daily smokers had significantly higher dietary ED (8.45kJ/g and 7.9kJ/g, respectively) compared to those who never smoked (7.5kJ/g). Despite eating smaller portions, the average difference in ED meant that current daily smokers consumed approximately 840kJ (200cal) more per day than those who never smoked [44].

A large proportion of participants across all SEIFA quintiles exceeded the WCRF recommendations for ED_{food} of 5.23kJ/g [16]. This study found an average ED_{food} that was higher than that of other studies [11, 45]. The discrepancy between the findings of this study and other studies could be due to differences in the categorisation of what was considered a food or a beverage (e.g. liquid meal replacement or cereal with milk). $ED_{food+bev}$ was similar to other studies, which found energy-densities of food to range between 7.24kJ/g and 7.18kJ/g [11, 45]. The similarity between the $ED_{food+bev}$ here to the ED_{food} of other studies could be explained by additions to food and beverages influencing the ED. A difference of approximately 2.1kJ/g (0.5kcal/g) in ED was found between two studies [46, 47] in a systematic review, due to the exclusion of beverages from the analyses [43]. The insignificant results found for ED_{bev} and $ED_{food+bev}$ could be explained by the effect that beverages has on ED. Beverages have a high water content, and may disproportionately influence dietary ED [48, 49]. However, beverages contribute to overall energy intake, therefore it is important to analyse beverages separately rather than removing them from analyses completely [50].

The proportion of core foods and discretionary items could explain the high ED of food found across all SEIFA quintiles. This study found that the majority of foods and beverages contributing the most energy were being consumed in large quantities and were mostly discretionary items. These included takeaway pizzas, deep-fried foods and alcoholic beverages. Studies have found that differences in dietary ED were mostly due to higher intakes of discretionary foods which were high in sugar, sodium, saturated fat and a lower intake of fruit and vegetables [11, 45]. One Australian study using diet quality scores, found that diet quality was inversely associated with dietary ED [11]. Improved dietary quality was associated with higher intakes of fruit and vegetables, with lower intakes of discretionary foods [11, 45]. Higher quality diets were associated with higher levels of SES in an American study, however were more costly per approximately 8400kJ (2000kcal) [41].

By using a sample taken from an Australian national data set, the findings of this study are generalisable to the Australian female population who are breastfeeding or in the preconception period. Representative data allows the study to be transferable, however may only comparable with similar, high-income countries using similar methodologies to collect their national data. Limitations of this study include the cross-sectional design which provides an insight into the ED and nutritional adequacy of the diets of childbearing aged women, however it cannot demonstrate causation. Although 24-hour dietary recalls are considered a reliable and valid method of dietary assessment, there are several limitations [51]. This analysis only reported on the group average intake relative to a single day as one 24-hour dietary recall was used for each participant, therefore we were unable to derive usual intake. Measurement error is inevitable when data is self-reported due to the estimation of food portions, composition of foods, and recalling foods consumed the day prior to recall [52]. Low energy reporting and underreporting of high energy-dense and discretionary items is likely due to recall bias and perceived social desirability.

Overall, our findings suggest that Australian women of childbearing age may not be consuming an optimal diet to ensure nutritional readiness for pregnancy. Given the high dietary ED, it is important to improve dietary quality in this group through a reduction in ED. Further research is needed to identify the factors affecting the nutritional preparedness of childbearing aged women for pregnancy. Identifying these factors may improve the health of Australian childbearing aged women and improve birth outcomes. In addition, additional investigation into the nutrient intakes and the sources of these (supplements, discretionary items, core foods) is needed. The preconception period, irrespective of pregnancy planning, provides an opportunistic period for health care professionals to educate and encourage health promoting behaviours, to improve maternal health, birth outcomes and reduce the risk of chronic disease in offspring.

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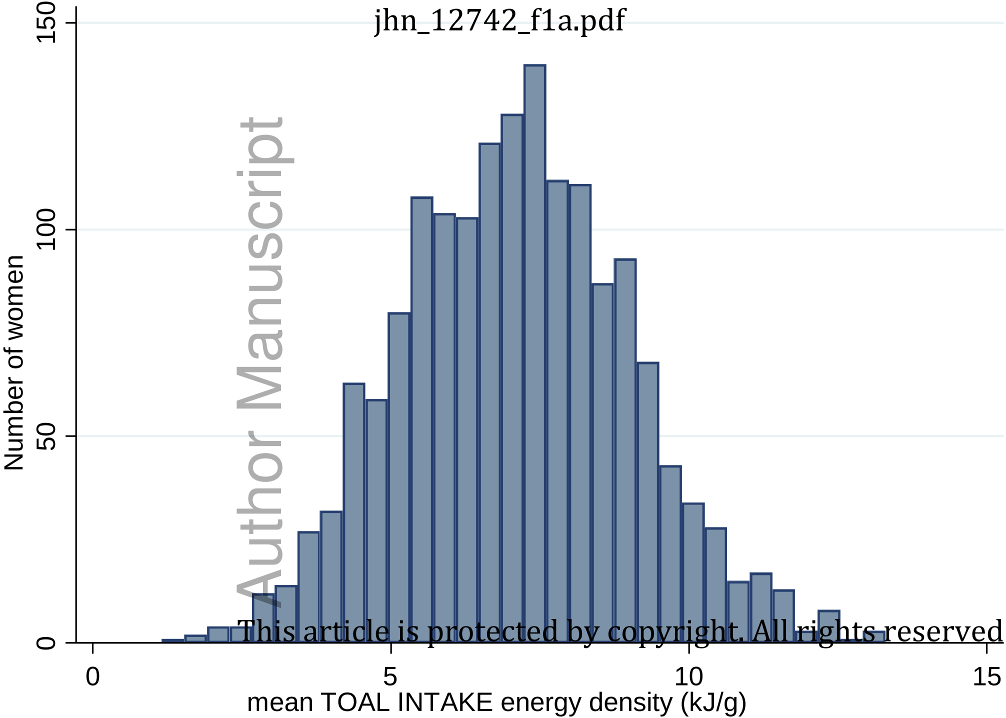
Supplementary Materials

Supplementary Figure 1. Energy-Density Methods Flowchart

[insert supplementary figure 1 here]

Supplementary Figure 2. Reported foods and beverages with the highest energy-density and weight/energy.

[insert supplementary figure 2 here]


Number of women
0
50
100
150
0
5
10
15
mean TOAL INTAKE energy density (kJ/g)

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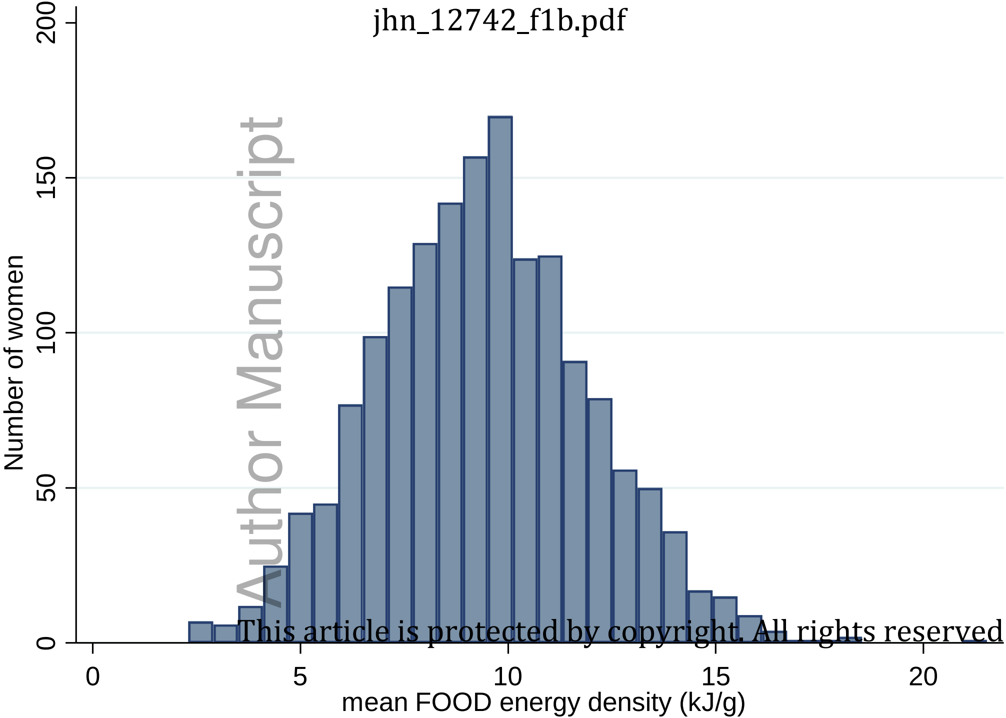

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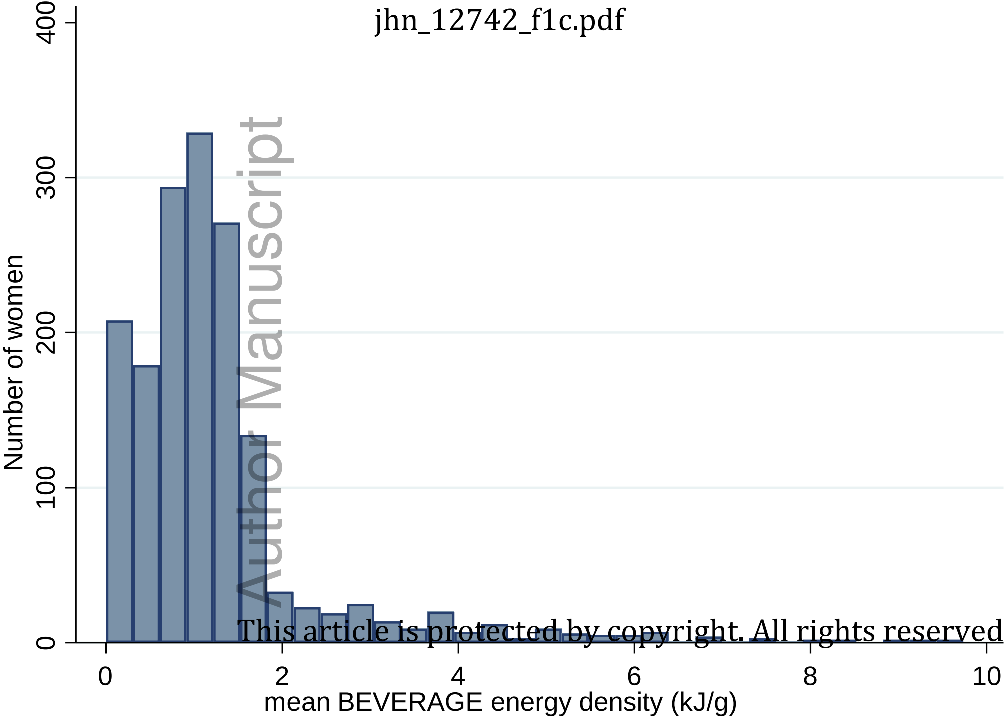
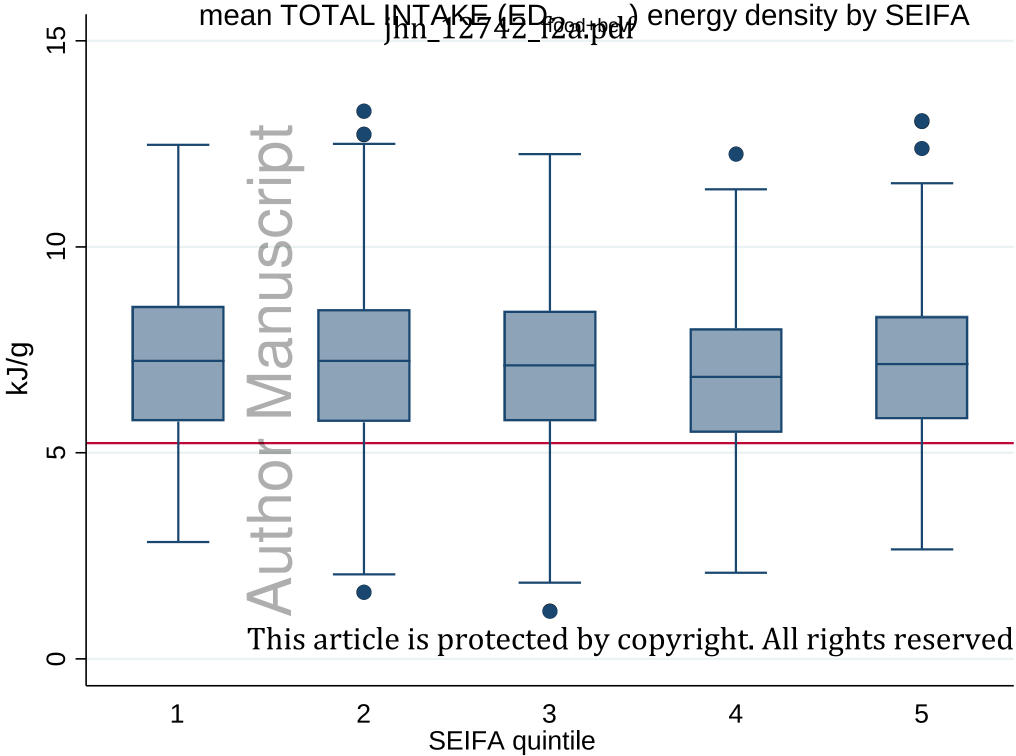
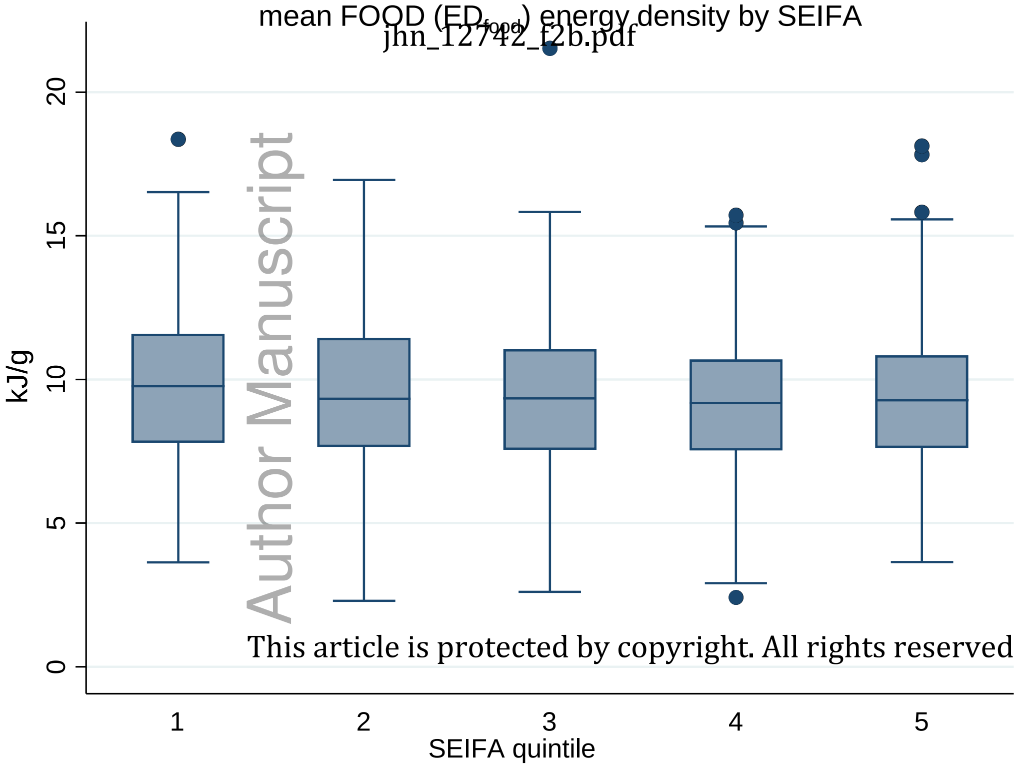



mean TOTAL INTAKE (ED food+bev) energy density by SEIFA
15
10
5
0
kJ/g
1
2
3
4
5
SEIFA quintile


mean FOOD (ED_{food}) energy density by SEIFA
kJ/g
0
5
10
15
20
1
2
3
4
5
SEIFA quintile

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