# Do women change their health behaviours in pregnancy? Findings from the Southampton Women's Survey

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## SUMMARY

A woman's lifestyle choices before and during pregnancy have important implications for her unborn child, but information on behaviour can be unreliable when data are collected retrospectively. In particular there are no large longitudinal datasets that include information collected prospectively before pregnancy to allow accurate description of changes in behaviour into pregnancy.

The Southampton Women's Survey is a longitudinal study of women in Southampton, UK, characterised when they were not pregnant and again during pregnancy. The objective of the analyses presented here is to describe the degree to which women comply with diet and lifestyle recommendations before and during pregnancy, and changes between these time points.

The analyses are based on 1490 women who delivered between 1998 and 2003 and who provided information before pregnancy and at 11 and 34 weeks gestation. At each time point a trained research nurse ascertained smoking status and assessed food and drink consumption using a food frequency questionnaire. We derived the proportions of women who complied with recommendations not to smoke, to eat five portions of fruit and vegetables per day and to drink no more than four units of alcohol per week and 300mg of caffeine per day.

There was a notable reduction in smoking when women became pregnant; before pregnancy 27% of women smoked, whereas in early pregnancy 15% smoked. Similarly there were significant reductions in alcohol consumption and intake of caffeinated drinks; before pregnancy 54% of women drank more than 4 units of alcohol per week and 39% had estimated intakes of caffeine in drinks of more than 300mg per day, whereas comparable figures for early pregnancy were 10% and 16% respectively. However, there was little change in fruit and vegetable intake; the percentages of women who did not achieve the recommendation to eat at least five portions of fruit and vegetables per week were 47% before pregnancy and 46% in early pregnancy. Younger women and those with fewer educational qualifications were less likely to comply with public health recommendations. 81% of women in early pregnancy complied with at least three of the recommendations. Although there is encouraging evidence of changed health behaviours in pregnancy, young women and those with few educational qualifications may particularly benefit from targeted health initiatives.

### Keywords

Pregnancy; smoking; alcohol drinking; fruit and vegetables; caffeinated drinks

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# INTRODUCTION

A woman's diet and smoking during pregnancy are known to have important implications for her unborn child, both in terms of immediate health outcomes such as neurodevelopmental disorders[1], birthweight[2] and pre-term birth[3-5], and potentially for the child's own life course.[6] Pregnant women in the UK are advised not to smoke, to eat at least five portions of fruit and vegetables per day, and to consume less than 300mg of caffeine per day.[7] Until recently, women planning a pregnancy in the UK were encouraged to limit alcohol consumption to one or two units, once or twice a week. In 2007 the advice was modified to urge women to avoid alcohol altogether but at most drink one or two units, once or twice a week.[7] Although there is some current information available about young women's smoking and dietary choices[8-11], there are few large longitudinal datasets to allow description of changes in behaviour between time points, and none that include data collected on behaviours before pregnancy.

This paper reports smoking, alcohol, fruit and vegetable and caffeinated drink consumption before pregnancy and in early and late pregnancy in the Southampton Women's Survey (SWS). Previous studies about health behaviours before pregnancy have collected data retrospectively, whereas in the SWS information before pregnancy was collected at the time when they were not pregnant. Thus we have a unique opportunity to study changes in behaviour without the errors associated with recall bias. We have also explored predictors of behaviours at each time point in these young women.

# METHODS

## Participants

The Southampton Women's Survey has assessed the diet, body composition, physical activity and social circumstances of a large group of non-pregnant women aged 20 to 34 years living in the city of Southampton, UK. Full details of the study have been published previously.[12] Women were recruited between April 1998 and December 2002 through general practices across the city. Each woman was sent a letter inviting her to take part in the survey, followed by a telephone call when an interview was arranged. In total 12,583 women agreed to take part in the survey, 75% of all women contacted. Trained research nurses visited the women at home and collected detailed information about their health, diet and lifestyles.

The women who subsequently became pregnant visited the SWS Ultrasound Unit at 11, 19 and 34 weeks' gestation. At 11 and 34 weeks gestation a trained research nurse collected similar information as at the interview before pregnancy, about health, diet and lifestyle. Pregnancy data are available on those women who gave birth before the end of 2003; results are presented here for 1490 women who were interviewed at all three time points.

All data for the Southampton Women's Survey were directly entered onto laptop computers where possible. The SWS was approved by the Southampton and South West Hampshire Local Research Ethics Committee and written consent was obtained from participants.

## Measurements

At each interview, food intake over the preceding three months was assessed using an interviewer-administered 100-item food frequency questionnaire (FFQ). Prompt cards were used to ensure standardised responses to the FFQ; further details are given by Robinson *et al*.[13] Fruit and vegetable consumption was calculated as defined by Williams.[14] Alcohol intake and frequency of caffeinated drink consumption (defined as caffeinated tea, caffeinated coffee and cola) were ascertained from the FFQ responses. Estimated caffeine

intake was calculated using the Food Standards Agency estimates of 100mg per mug of coffee, 50mg per cup of tea and 40mg per can of cola.[7] Current smoking status (Yes/No) was reported at each interview.

At both visits in pregnancy the woman described any nausea and vomiting she had experienced in the preceding three months as 'none', 'mild (nausea only)', 'moderate (occasional vomiting)' or 'severe (frequent vomiting)'. Height and weight were measured before pregnancy; height was measured with a portable stadiometer (Harpenden; CMS Weighing Equipment Ltd, London, UK) to the nearest 0.1 cm with the head in the Frankfort plane. Weight was measured with calibrated electronic scales (Seca, Hamburg, Germany) to the nearest 0.1 kg and the women were asked to remove their shoes and any heavy items of clothing or jewellery. This information was used to calculate body mass index (BMI) before pregnancy.

## Statistical methods

Differences between women in the present study and others in the complete SWS non-pregnant cohort were tested using t-tests for continuous variables and chisquared tests for binary variables. Subsequent statistical tests were based on behaviours expressed as binary variables. Changes in behaviours were tested using McNemar's test for paired proportions. Predictors of behaviours were assessed using Poisson regression with robust variance to enable calculation of relative risk.[15] Univariate predictors with significance $< 0.2$ were entered into the multivariable model, where only predictors with significance $< 0.05$ were retained. The variables considered as potential influences on behaviour were maternal age at child's birth, education, BMI, gestation and degree of nausea and vomiting. Education (across six levels ranging from 'none' to 'degree') and nausea (across four levels ranging from 'none' to 'severe') were treated as continuous variables in the analyses. BMI was transformed to normality using Fisher-Yates normal scores.[16] Statistical analysis was performed using Stata 10.0.[17]

# RESULTS

## Sample characteristics

Study characteristics of the 1490 SWS participants with data at all three time points are given in Table 1, alongside the non-pregnant characteristics of women not in the present study but in the complete SWS cohort. The complete cohort has been shown to be broadly representative of women of this age group in the UK in terms of smoking and higher educational profile, although the proportion of white women is somewhat higher than the national figure of 88%.[12] Women in the present study were a similar age and height, but of slightly higher BMI, than other women in the full non-pregnant SWS cohort. The 1490 women were also somewhat better educated than others in the SWS non-pregnant cohort, and less likely to smoke or to be from a non-white ethnic group. Of the 1490 women who had data at all three time points, the median time to conception was one year from the initial interview. There was a notable decrease in level of nausea and vomiting experienced between early and late pregnancy.

## Descriptions of longitudinal changes in behaviours

Smoking, alcohol, fruit and vegetable, and caffeinated drink intake reported at each of the three time points are shown in Table 2. Fewer women smoked in pregnancy than before pregnancy. In early pregnancy there was evidence of a drop in the number of cigarettes smoked per day amongst those who continued to smoke, although this trend was less apparent in late pregnancy. Similarly alcohol intakes were lower in pregnancy, such that 5% of women in late pregnancy drank more than four units per week, compared to 54% of

women before pregnancy. In early pregnancy there was a substantial decrease in alcohol units consumed per week amongst women who continued to drink, and this was maintained into late pregnancy. There was little change in fruit and vegetable intake across the three time points. The proportion of women consuming less than the recommended five portions of fruit and vegetables similarly showed little change between before, early and late pregnancy, at 47%, 46% and 44% respectively. However, there was a notable decrease in caffeinated drink consumption; the proportions of women with estimated caffeine intakes above 300mg per day were 39% before pregnancy, 16% in early pregnancy and 19% in late pregnancy.

The four behaviours under consideration have been dichotomised to indicate whether each woman complied with recommendations. The women were divided into those who smoked and those who did not. Alcohol was dichotomised at four units per week, to indicate whether women complied with the contemporaneous pregnancy recommendation to have 1-2 units of alcohol once or twice a week.[7] Fruit and vegetable intake was dichotomised at five portions a day.[14] The women were also divided into those that complied with the pregnancy recommendation to consume less than 300mg of caffeine per day[7] and those that did not. The recommendations for smoking and fruit and vegetable intake apply to women at all time points, whereas those for alcohol and caffeinated drinks only apply to women during pregnancy. However, the same definitions are applied before pregnancy for comparison. The proportions of women complying with all four recommendations before pregnancy and in early and late pregnancy were 15%, 39% and 42% respectively, and the proportions complying with three or more recommendations were 48%, 81% and 82%.

### Description of longitudinal changes in compliance with recommendations

The pattern of individual women's longitudinal changes in smoking, alcohol intake, fruit and vegetable intake and caffeinated drink intake are shown in Table 3 and Table 4. The participants markedly reduced smoking in early pregnancy, when 15% of the women smoked, compared to before pregnancy, when 27% of the women smoked ($P < 0.001$); 192 women stopped smoking between before and early pregnancy (48% of all those who smoked before pregnancy), whilst only 12 women reported starting smoking (Table 3). It is possible that some changes occurred before the women became pregnant, so women who reported starting smoking may not have started in pregnancy but instead in the time between the initial interview and conception. There was little reduction in late pregnancy, when 14% of the women smoked, compared to early pregnancy ($P = 0.15$) (Table 4). There was a notable reduction in alcohol intake in early pregnancy, when 54% of the women drank more than four units of alcohol per week, compared to before pregnancy, when 10% of the women drank more than the recommended amount of alcohol. ($P < 0.001$). There was a further smaller reduction between early and late pregnancy, when 5% of the women were drinking more than the maximum recommended amount of alcohol ($P < 0.001$). Of the 801 women who drank above the recommended limit before pregnancy, 665 (83%) drank four units or less per week in early pregnancy. Between before and early pregnancy 214 women started eating five portions of fruit and vegetables per day and 221 women stopped, leading to little overall change in fruit and vegetable consumption (47% did not comply with the recommendation before pregnancy compared to 46% in early pregnancy, $P = 0.74$). Similarly there was little overall change between early and late pregnancy, when 44% did not comply with the recommendation, $P = 0.07$). The SWS women drank markedly fewer caffeinated drinks in early pregnancy compared to before they became pregnant; 39% of women had estimates of caffeine intake of more than 300mg per day before pregnancy, compared to 16% in early pregnancy ($P < 0.001$). 65% of those with estimated caffeine intakes of more than 300mg of caffeine before pregnancy consumed below this limit in early pregnancy. In further analyses this reduction was mainly due to a decrease in tea and coffee

consumption, and to a lesser extent cola (data not shown). Consumption of caffeinated drinks actually increased slightly between early and late pregnancy, when 19% of women had estimated intakes above the recommendation (P = 0.004).

### Predictors of behaviours

Significant predictors of behaviours in multivariable models are shown in Table 5. Women who smoked before pregnancy tended to be younger and have fewer educational qualifications. These were consistent patterns throughout pregnancy with the effect of education being particularly strong in pregnancy. In early pregnancy the relative risk of smoking associated with an increase of one level of education was 0.59 [95% CI 0.54, 0.65]. In early pregnancy only 2% of women with a degree smoked, whereas 50% of women with no qualifications smoked. In late pregnancy women who were more nauseous were more likely to smoke. Predictors of drinking more than four units of alcohol per week were less consistent across time points. Before pregnancy women with more qualifications and lower BMI were likely to drink more than the recommended limit for pregnancy, whereas in early pregnancy women with a lower BMI and with less nausea and vomiting tended to consume more alcohol. In late pregnancy the only significant predictor of drinking more than four units of alcohol per week was being older.

At each of the three time points women who ate less than five portions of fruit and vegetables a day tended to be younger and have fewer educational qualifications. Women not achieving the recommended amount of fruit and vegetable intake tended to be more nauseous in early pregnancy and to have a higher BMI in late pregnancy. Having fewer educational qualifications was a consistent predictor of drinking more than 300mg of caffeine at each time point. Further analysis indicated that at each time point women with less education generally drank somewhat more tea and coffee, but markedly more cola (data not shown). There was an additional effect of gestation in early pregnancy, such that women at a later gestation drank fewer caffeinated drinks.

Additional analyses explored predictors of continuing to exhibit adverse health behaviours into early and late pregnancy, but revealed little further information to that in Table 5 (data not shown).

## DISCUSSION

### Statement of principal findings

Compared with the period before pregnancy, there were marked falls in smoking, alcohol and caffeinated drink intake in early pregnancy, and these patterns of behaviour tended to continue into late pregnancy. However, there was little change in overall levels of fruit and vegetable consumption. In early pregnancy 15% of women smoked, 10% drank more than four units of alcohol per week, 46% ate less than five portions of fruit and vegetables per day, and 16% had estimated caffeine in drinks of more than 300mg per day; 81% of women complied with at least three recommendations at this time point.

Education was strongly associated with these behaviours, such that women with fewer educational qualifications tended to smoke, eat less fruit and vegetables and drink more caffeinated drinks at all time points. However, before pregnancy women with more qualifications were likely to consume above four units of alcohol per week. There was also a detrimental effect associated with age: younger women were more likely to smoke and to eat fewer portions of fruit and vegetables, although in late pregnancy there was also a small effect of younger women tending to drink less than four units of alcohol per week.

## Comparison with other studies

The rate of smoking amongst non-pregnant women in the SWS (27%) is somewhat less than women aged 25-34 years in the General Household Survey 2000 (32%).[18] The rate of smoking during early pregnancy in the SWS (15%) was substantially lower than 27% found in a survey of pregnant women in England in 1997.[9] This may be partly due to SWS data being collected at a later time point (1998 to 2003); the smoking rate amongst pregnant women in Southampton has dropped as a 1991-1992 study in the city using the same methods showed 26% of women were smokers in early pregnancy.[10] The SWS data support the conclusion from a survey of pregnant women in England in 1997[9] that most women who stop smoking during pregnancy do so in the first trimester.

Non-pregnant rates of any alcohol consumption in the SWS (91%) were very similar to those recalled by women in the ALSPAC study (92%) and also similar to that reported by women aged 20-34 in the Health Survey for England (86%).[8] However, in early pregnancy the 70% of women drinking in the SWS was substantially more than the 55% drinking in the ALSPAC study[11]; one possibility is that this may be partly because the ALSPAC women were enrolled about a decade earlier than the SWS women.

## Strength and weaknesses of the study

A unique strength of the SWS is that the data were collected prospectively before pregnancy rather than being subject to recall bias. Thus the SWS provides a very valuable resource for comparisons of health behaviours in pregnancy with those before pregnancy. Data are available from a large cohort of women with a good response rate: 75% of the women contacted agreed to take part in the study. Since data were interviewer-collected, completion rates were high.

One limitation of our study is that the data on health behaviours are reported and therefore could be subject to bias. In particular pregnant women may feel a greater pressure to report good health behaviours. However, taking smoking as an example, Graham and Owen[19] found that amongst pregnant women surveyed in 1999, 29% reported smoking whereas 32% smoked according to cotinine validation, so the level of underreporting does not appear to be large.

Since data were collected prospectively before pregnancy in the SWS there was inevitably a time interval before conception. The median time to conception in this cohort was only one year, but some variability in health behaviours between before and early pregnancy will be due to changes before conception, rather than during pregnancy. However, a study of dietary patterns amongst non-pregnant women in the SWS showed reasonable stability over a 2-year period.[20] Also, when analyses were restricted to those women who conceived within a year the predictors of dietary behaviours were very similar to those presented here (data not shown).

The women in this cohort had data at all three time points and were somewhat different to others in the SWS non-pregnant cohort (Table 1). This is largely because women who provided data in early pregnancy were better educated and were more likely to be white and non-smokers. However, it is unlikely that this would cause the changes in behaviours seen across time points, or the associations with predictors, and we are therefore confident that these data have relevance beyond Southampton.

At the time women participated in the SWS the recommendation was to consume drinks containing caffeine in moderation.[21] Therefore when the guideline was not quantified the women drinking more than the recommended number of cups of tea, coffee or cola may have considered this level moderate.

## Interpretation and implications

SWS women significantly reduced their consumption of cigarettes, alcohol and caffeinated drinks in pregnancy, providing encouraging evidence of changed health behaviours in pregnancy in response to advice. The lowest rates of compliance in pregnancy were for the recommendation to eat at least five portions of fruit and vegetables per day, and there was very little overall change in fruit and vegetable consumption from before pregnancy to during pregnancy; either women did not see this advice as specifically relevant to pregnancy or did not wish to act upon this health guideline.

Women with fewer educational qualifications were more likely to smoke, to eat less fruit and vegetables and to drink more caffeinated drinks. Although non-pregnant women with fewer qualifications were likely to consume less alcohol, in pregnancy there was no association between drinking more than four units per week and education. Thus women with more education seem to be able to respond to the guideline about limiting alcohol intake in pregnancy. Women who are younger are more likely to smoke and to eat fewer portions of fruit and vegetables. Therefore young women and poorly educated women in the SWS appear to be particularly vulnerable groups who tend to make less appropriate lifestyle choices in pregnancy and who may therefore require targeted advice to encourage compliance with healthy lifestyle choices.

## Acknowledgments

## Abbreviations

**FFQ**    food frequency questionnaire

**SWS**    Southampton Women's Survey

**BMI**    body mass index

**RR**    relative risk

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**Table 1**

Descriptive statistics for the 1490 women with data in early and late pregnancy and other women in the full SWS non-pregnant cohort

| Characteristic | In present study | Not in present study | P-value |
|---|---|---|---|
| n | 1490 | 11093 | |
| Age at non-preg. interview, years [mean (SD)] | 28.2 (3.7) | 28.2 (4.3) | 0.96 |
| Height, m [mean (SD)] | 1.63 (0.06) | 1.63 (0.06) | 0.08 |
| Non-pregnant BMI, kg/m$^2$[median (IQR)] | 24.3 (22.1 to 27.7) | 24.1 (21.7-27.5) | 0.009 |
| Ethnic group, n (%) | | | |
| - White | 1433 (96.2) | 10379 (93.8) | < 0.001 |
| - Non-white | 57 (3.8) | 686 (6.2) | |
| Highest educational attainment, n (%) | | | |
| - None | 34 (2.3) | 690 (6.3) | < 0.001 |
| - GCSE grade D or below | 153 (10.3) | 1240 (11.2) | |
| - GCSE grade C or above | 422 (28.4) | 2901 (26.3) | |
| - A level or equivalent | 435 (29.3) | 3300 (29.9) | |
| - HND or equivalent | 116 (7.8) | 611 (5.5) | |
| - Degree | 326 (21.9) | 2290 (20.8) | |
| Smoking before pregnancy, n (%) | | | |
| - No | 1093 (73.4) | 7604 (68.7) | < 0.001 |
| - Yes | 397 (26.6) | 3470 (31.3) | |
| Time to conception, years [median (IQR)] | 1.0 (0.4-1.8) | | |
| Gestation at early preg., weeks [median (IQR)] | 11.8 (11.4-12.4) | | |
| Gestation at late preg., weeks [median (IQR)] | 34.6 (34.3-34.9) | | |
| Nausea and vomiting in early pregnancy, n (%) | | | |
| - None | 165 (11.1) | | |
| - Mild | 704 (47.3) | | |
| - Moderate | 450 (30.2) | | |
| - Severe | 170 (11.4) | | |
| Nausea and vomiting in late pregnancy, n (%) | | | |
| - None | 799 (53.6) | | |
| - Mild | 429 (28.8) | | |

| Characteristic | In present study | Not in present study | P-value |
|---|---|---|---|
| - Moderate | 230 (15.4) | | |
| - Severe | 32 (2.2) | | |

**Table 2**

Description of behaviours before and during pregnancy

| Characteristic | Before pregnancy | Early pregnancy | Late pregnancy |
|---|---|---|---|
| Dates | Apr 98 – Oct 02 | Jun 98 – Jul 03 | Dec 98 – Dec 03 |
| Smoking, % | | | |
| None | 73 | 85 | 86 |
| -10 cigarettes/day | 15 | 12 | 10 |
| >10 cigarettes/day | 12 | 3 | 4 |
| Cigarettes/day amongst smokers [median (IQR)] | 10 (7 – 15) | 8 (5 – 10) | 10 (5 – 15) |
| Alcohol, % | | | |
| None | 9 | 29 | 31 |
| - 4 units/week | 37 | 60 | 63 |
| - 21 units/week | 45 | 9 | 5 |
| >21 units/week | 8 | 1 | 0.1 |
| Alcohol units/week amongst drinkers [median (IQR)] | 5.5 (2.1 – 11.6) | 0.8 (0.3 – 2.3) | 0.6 (0.3 – 1.7) |
| Portions of fruit and veg/day [median (IQR)] | 5.2 (3.7 – 7.0) | 5.3 (3.7 – 7.0) | 5.4 (3.9 – 7.2) |
| Caffeinated drinks/day [median (IQR)] | 4.1 (2.0-6.0) | 2.0 (0.6-4.1) | 2.3 (0.9-4.3) |

**Table 3**

Changes in behaviour between before and early pregnancy (n (%))

| Before pregnancy | | Early pregnancy | |
|---|---|---|---|
| | | No | Yes |
| **Smoking** | **No** | 1079 (73%) | 12 (1%) |
| | **Yes** | 192 (13%) | 205 (14%) |
| **Drinking more than four units of alcohol per week** | **No** | 673 (45%) | 15 (1%) |
| | **Yes** | 665 (45%) | 136 (9%) |
| **Eating less than five portions of fruit and vegetables per day** | **No** | 582 (39%) | 214 (14%) |
| | **Yes** | 221 (15%) | 473 (32%) |
| **Drinking more than 300 mg of caffeine in drinks per day** | **No** | 870 (58%) | 41 (3%) |
| | **Yes** | 375 (25%) | 204 (14%) |

**Table 4**

Changes in behaviour between early and late pregnancy (n (%))

| Early pregnancy | | Late pregnancy | |
|---|---|---|---|
| | | **No** | **Yes** |
| **Smoking** | **No** | 1256 (84%) | 15 (1%) |
| | **Yes** | 24 (2%) | 193 (13%) |
| **Drinking more than four units of alcohol per week** | **No** | 1297 (87%) | 41 (3%) |
| | **Yes** | 116 (8%) | 35 (2%) |
| **Eating less than five portions of fruit and vegetables per day** | **No** | 623 (42%) | 180 (12%) |
| | **Yes** | 216 (14%) | 471 (32%) |
| **Drinking more than 300 mg of caffeine in drinks per day** | **No** | 1115 (75%) | 130 (9%) |
| | **Yes** | 88 (6%) | 157 (11%) |

**Table 5**

Relative risks (95% CI) of predictors of health behaviours (one mutually adjusted model for each outcome at each time point)

| Outcome | Predictor | Before pregnancy | Early pregnancy | Late pregnancy |
|---|---|---|---|---|
| **Smoking** | Age (years) | 0.94 [0.92, 0.96] | 0.93 [0.90, 0.96] | 0.94 [0.91, 0.97] |
| | Educational level | 0.73 [0.69, 0.78] | 0.59 [0.54, 0.65] | 0.61 [0.56, 0.67] |
| | Nausea category | | | 1.33 [1.17, 1.53] |
| **Drinking more than four units of alcohol per week** | Age (years) | | | 1.11 [1.04, 1.18] |
| | Educational level | 1.08 [1.04, 1.11] | | |
| | BMI (SDs) | 0.93 [0.89, 0.98] | 0.85 [0.75, 0.97] | |
| | Nausea category | | 0.81 [0.67, 0.99] | |
| **Eating less than five portions of fruit and vegetables per day** | Age (years) | 0.97 [0.95, 0.98] | 0.97 [0.96, 0.99] | 0.96 [0.95, 0.98] |
| | Educational level | 0.83 [0.80, 0.87] | 0.83 [0.79, 0.86] | 0.80 [0.76, 0.83] |
| | BMI (SDs) | | | 1.10 [1.05, 1.16] |
| | Nausea category | | 1.09 [1.02, 1.16] | |
| **Drinking more than 300mg of caffeine in drinks per day** | Educational level | 0.89 [0.85, 0.94] | 0.74 [0.67, 0.80] | 0.74 [0.69, 0.81] |
| | Gestation (weeks) | | 0.81 [0.68, 0.96] | |