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Evidence Briefing

How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

Nicola Pearce-Smith
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How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

**Question**

This briefing summarises the evidence on five risk factors in pregnancy (use of alcohol, smoking, maternal obesity, folic acid supplementation and timing of antenatal care) for women of different ages and socioeconomic status (SES), from Jan 2008 to Nov 2017.

**Key messages**

- **advanced maternal age (AMA) of 35yrs or older** was often associated with an increased risk of stillbirth, low birthweight, preterm birth, Caesarean section, aneuploidy, non-chromosomal abnormalities, congenital heart defects and having an adverse obstetric outcome/pregnancy complication, compared with younger women; AMA >40 yrs was associated with increased risk of pre-eclampsia
- many of the pregnancy complications in women giving birth aged 48 or over can be explained by multiple pregnancy
- there was no agreement in the research on the risk of AMA for small for gestational age (SGA) babies - both >40 yrs and <30 yrs has been associated with increased risk; one study found no evidence that SGA differed with maternal age at all
- on the whole, women >30 yrs were more likely to drink alcohol during pregnancy
- a strong link was demonstrated between alcohol use, folic acid deficiency, obesity, and an increased risk of congenital anomalies, but few proven links between smoking and specific birth defects
- maternal obesity, AMA and maternal smoking were the most relevant modifiable factors, contributing to more than 8000, 4000 and 2800 stillbirths, respectively, in all high income countries
- AMA women with stillbirth were significantly more likely to be currently smoking; the probability of stillbirth was greatest among older smokers, followed by younger smokers and lowest among younger non-smokers
- smoking in pregnancy increased the risk of low birth weight births for women <25yrs
- maternal smoking increased odds of preeclampsia
- AMA women (age 35-44yrs) with body mass index (BMI) 40+ increased the odds of congenital heart defects; also the combined effect of AMA and either overweight or obesity appeared to be a high risk for stillbirth and preterm delivery
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

- extremely obese teenagers were almost 4 times as likely to develop preeclampsia/eclampsia compared with non-obese women aged 20-24 years
- women least likely to take folic acid are younger, have lower income or lower socioeconomic status, a lower educational level and are smokers
- pregnant adolescents present to hospitals for prenatal care at a much more advanced gestational age compared with adults, and the risks of preterm delivery and preeclampsia were greater among these adolescents
- low maternal age, low educational level and smoking during pregnancy were factors of inadequate use of prenatal healthcare
- employment status was significantly associated with many common risk factors for adverse pregnancy outcomes including maternal age, BMI, body smoking, alcohol consumption and household income
- adolescent mothers that lived in areas of high neighbourhood risk were significantly more likely to have infants of low birth weight than mothers living in areas of low neighbourhood risk
- infants of the lowest educated women had a significantly lower birthweight than infants of the highest educated women, which could be explained in part by factors such as smoking
- compared with the least deprived areas, the most deprived areas had a higher rate of live births and neonatal mortality rate associated with a congenital anomaly
- risk of preterm birth and preeclampsia is greater among the educationally most disadvantaged
- the prevalence of SGA was higher in municipalities with an intermediate or high unemployment rate than municipalities with the lowest unemployment rate
- current smoking status was a strong predictor of alcohol risk status in pregnancy
- socially deprived/low SES women or those of lower education were more likely to smoke in pregnancy; smoking was a risk factor for adverse obstetric outcomes for low SES women, and the least educated women had a higher risk of preterm birth than highly educated women
- maternal smoking had a negative association with birth weight which was highly variable between neighbourhoods - high SES had a strong positive association with birth weight but the effect was moderated with increased smoking; conversely, heavy smokers showed the largest increases in birth weight with rising neighbourhood education levels
- women with obesity were more likely to access care late (in the third trimester) compared with women with a recommended BMI
- women living in more socioeconomically deprived areas (e.g. neighbourhoods with higher rates of unemployment and low-educated residents) and younger women often have inadequate use of antenatal care, although one study showed that neighbourhood SES had no association with late initiation of antenatal care
- late antenatal care was associated with an increased risk of both neonatal and infant death, teenage pregnancy, unemployment, smoking and poor fetal outcomes
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

**Background**

There are many risk factors for pregnancy complications or adverse birth outcomes – some are modifiable such as alcohol use, smoking, obesity in pregnancy, taking folic acid supplements or attending antenatal care; others are non-modifiable such as the age or socioeconomic status of the mother. This Evidence Briefing looks at the risks in pregnancy associated with maternal age and maternal socioeconomic factors, and examines how the five modifiable risks vary with the age or socioeconomic status of the mother.

**1. Maternal Age**

Women giving birth at AMA or very AMA may have greater risks of a range of pregnancy complications and adverse obstetric outcomes; teenagers/very young mothers may also be at higher risk.

- **Stillbirth**
  - greater maternal age was associated with an increased risk of stillbirth - relative risks (RR) varied from 1.20 to 4.53 for older versus younger women (1); - AMA increased risk of stillbirth (OR 1.75, 95%CI 1.62 to 1.89) with a population attributable risk of 4.7% (2); - stillbirth rates increased by maternal age: 25-29 years 0.27%; 30-34 years 0.31%; 35-39 years 0.40%; and >40 years 0.53% (3); - when compared with women 25 to 29 years of age, the risk of intrauterine fetal demise increased with advancing age: 30 to 34 years, odds ratio [OR] = 1.24 (95% confidence interval [CI], 1.13 to 1.36); 35 to 39 years, OR = 1.45 (95% CI, 1.21 to 1.74), and 40 to 44 years, OR = 3.04 (95% CI, 1.58 to 5.86) (4)
  - two studies found no increased risk of stillbirth with increasing maternal age (5) (6)

- **Caesarean section (CS)**
  - increased risk among women at advanced maternal age compared with younger women (7) (5)
  - in women aged 20 to 34, 35 to 40, and over 40, rates of CS were 26.2%, 35.9%, and 43.1%, respectively (out of 134 088 deliveries) (8)
  - increased risk for caesarean delivery, most notably for elective caesareans - RR 1.64 95% CI 1.36-1.96 for age 25-29, rising to 4.94 95% CI 4.09-5.96 for age >=40 (6)

- **Adverse obstetric outcomes/pregnancy complications**
  - From 47,951 singleton births, women aged 30-34 had 27% higher odds of an obstetric event compared to 25-29 year olds, while women aged 40 and older had 61% higher odds (9); this paper also states that “while women of extremely advanced maternal age face the highest risk as individuals, prevention of maternal and neonatal morbidity
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*requires recognition that the highest proportion of maternal age-related obstetric events occur in women aged 30-39*

- a UK cohort study found that many of the pregnancy complications in women giving birth aged 48 or over can be explained by multiple pregnancy (10)
- an audit of 297 birth records of teenagers was compared with 293 non-teenage women delivering at an Australian hospital, and found more teenaged mothers were likely to encounter an adverse pregnancy outcome (46.1%), when compared to non-teenaged mothers (42.3%) (11)
- in a study of 955,804 women who gave birth in Sweden and Norway from 1990 to 2010, maternal age 30 years or older was associated with the same number of additional cases of fetal deaths (5251) as overweight or obesity (5251) (12) – the paper states “for the individual woman, the absolute risk for each of the outcomes was small, but for society, it may be significant as a result of the large number of women who give birth after the age of 30 years”

- Low birth weight (LBW)
  - women aged >=35 were at increased risk of low birthweight (6)

- Preterm birth
  - women aged >=35 were at increased risk of preterm birth (6)
  - risks of very preterm birth increased with maternal age, adjusted ORs in first, second, and third births ranged from 1.18 to 1.28 at 30-34 years, from 1.59 to 1.70 at 35-39 years, and from 1.97 to 2.40 >40 years; in moderately preterm births, age-related associations were weaker, but were statistically significant from 35-39 years (13)
  - from the national perinatal surveys in France, compared to 1995 maternal age>=35 years was no longer associated with preterm birth in 2010 (14)

- Birth defects
  - AMA confers an increased risk of aneuploidy, as well as nonchromosomal abnormalities (15)
  - AMA is associated with an increased OR of the aggregate outcome "Any Anomaly" in 35-39 and 40-44yr olds (OR1.3 CI[1.09- 1.56] and 1.7 CI[1.31-2.3]); OR for congenital heart defect (CHD) is significantly increased in the BMI >=40 groups (35-39yo OR4.15 CI[1.1-15.6] and 40-44yo OR8.01 CI[1.48-43.5]), though P>0.05 after controlling for Trisomy 21 (16)

- Preeclampsia
  - AMA >40 yrs was associated with increased risk of pre-eclampsia (5)

- Small for gestational age (SGA)
  - this study found that AMA >40 yrs was associated with increased risk of SGA (5)
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

- a population-based prospective cohort study from the Netherlands (Generation R study) found that younger mothers have an increased risk of SGA babies (as compared with mothers aged 30-34.9 years). whereas older mothers have an increased risk of large-for-gestational-age babies (17)
- another study found no evidence that the risk of SGA differed by maternal age (6)

1a) Alcohol

- Prevalence
  - from a dataset of 311,428 pregnant US women, 6.5% of women reported drinking alcohol during the last trimester of pregnancy - alcohol consumption by age group was: 3.7% for <=24, 5.7% for 25-29, and 10.1% for >=30 years of age. Women <=24 years were at greater risk of consuming alcohol if they also smoked (5.8%). 16% of women >=30 years with at least 16 years of education, White or Hispanic with normal or underweight BMI, drank alcohol during their last trimester (18)
  - women of 35 years or older were most likely to drink alcohol during pregnancy, in this survey of 9,004 pregnant women from the US (19)
  - a study of 907 women in the Republic of Ireland found that factors associated with continuing to drink in pregnancy included older maternal age (30-39 years) and smoking (20); perinatal outcomes were similar for non-drinkers and drinkers
  - mothers who gave birth after age 36 were twice as likely to be ‘Escalating Risk Drinkers’ and ‘Escalating Low Risk Drinkers’, when compared to mothers who gave birth between the ages of 26 and 35 in this US study of 9100 mothers (21)
  - this study of 456 women interviewed about alcohol use during pregnancy found that younger mothers were more likely to engage in risky drinking early in pregnancy, continuing 6 to 14 years postpartum (22)
  - a study looking at meconium samples (indicating alcohol exposure in pregnancy) from 235 Scottish women found no clear associations between alcohol use and maternal age or socioeconomic status (23)

- Miscarriage
  - maternal age at conception and alcohol consumption during pregnancy were the most important risk factors for miscarriage in this Danish study of 91,427 pregnancies (24)

- Birth defects
  - a recent literature review found a strong link between alcohol use and an increased risk of congenital anomalies (15)
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

1b) Smoking

- Stillbirth
  - maternal overweight and obesity (OR 1.2, 95% CI 1.09 to 1.38 and OR 1.6, 95% CI 1.35 to 1.95, respectively), advanced maternal age (>35 years) (OR 1.65, 95% CI 1.61 to 1.71) and maternal smoking (OR 1.40, 95% CI 1.27 to 1.46) were the most relevant modifiable factors, contributing to more than 8000, 4000 and 2800 stillbirths, respectively, in all high income countries according to this systematic review (25)
  - a cohort of 68,373 patients found that AMA women (>= 35 years) with stillbirth were significantly more likely to be currently smoking (p=0.02), African American (p<0.001), overweight (p=0.03), or have co-morbidities such as chronic hypertension (p=0.001) and diabetes (p<0.001); healthy women with AMA were 40% less likely to have a stillbirth (26)
  - a cohort of 1,436,628 singleton births in Missouri from 1978-1997 identified 5,772 counts of stillbirth, a rate of 4.0 per 1,000. About 33% (1,900) occurred among older smokers resulting in a stillbirth rate of 9.1 per 1,000; the probability of intrapartum stillbirth was greatest among older smokers, followed by younger smokers and lowest among younger non-smokers (P < 0.01) (27)

- Gestational size
  - in 172 pregnant smoking women with singleton gestation, adolescent age was independently associated with prolonged gestational age at delivery (maternal age < 19 associated with a 1 week extension of pregnancy) and had no independent effect on newborn size (28)

- Maternal mortality
  - this case-control study showed an association between maternal mortality and smoking during pregnancy among women aged 35 years or older (adjusted odds ratio OR 2.06, 95% CI 1.13-3.75), which may be due to more lengthy smoking exposure than in younger women (29)

- Adverse obstetric outcomes/pregnancy complications
  - an audit of 297 birth records of teenagers was compared with 293 non-teenage women delivering at an Australian hospital, and found more teenaged mothers were likely to encounter an adverse pregnancy outcome (46.1%), when compared to non-teenaged mothers (42.3%); a much higher proportion of teen mothers smoked antenatally (54.6% compared to 23.3%), but the teens were more likely to have a normal BMI of between 20-25 (56.2% versus 58.2%) (11)

- Preeclampsia
  - this US cohort study of 3,113,164 singleton pregnancies observed that compared with non-smokers, reduced odds of preeclampsia among pregnant smokers was only evident for non-Hispanic white and non-Hispanic American Indian women aged less than 35 years; non-
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Hispanic Asian/Pacific Islander women who smoked during pregnancy had increased odds of preeclampsia regardless of maternal age; non-Hispanic white and non-Hispanic black women 35 years or older who smoked during pregnancy also had increased odds of preeclampsia (30)

- Low birth weight
  - fourteen risk factors accounted for nearly half of LBW births, and 60% of those were to mothers <25 years, using data from published studies alongside prevalence data from the Welsh population; tobacco smoke exposure was the largest contributor - smoking in pregnancy was estimated as a factor in 1 in 8 LBW births, increasing to 1 in 5 for women aged under 25 (31); this paper concludes that "the most striking finding is that most risk factors are more prevalent in younger mothers"

1c) Obesity

Women who experienced their first birth at age 21 or younger had a BMI 5 units greater than women who delayed childbearing until at least age 30 (point estimate, 5.02; P = .02; 95% confidence interval, 0.65-9.40) in this US study of 146 women (32). In 2.6 million US pregnancies from 2003-2015, maternal weight increased by 5.3% for both entire cohort and for the top 10%; for teenagers, however, there was no overall maternal weight increase, except for the top 10% (33).

- Congenital malformations
  - analysis by BMI class showed a substantial increase in the odds of congenital heart defect in the offspring of women age 35-44 in the BMI class 40+ from 724,802 US pregnancies (16)

- Preterm birth (PTB)
  - among younger teenagers (<=15 years), higher BMI was associated with lower frequency of preterm birth, but among 19 year old mothers, obese mothers had higher PTB frequencies than overweight mothers and nearly equal to that of normal BMI, in this study of California live births to teenage mothers between 13 and 19 years (34)
  - maternal overweight and obesity along with AMA significantly increased the risks of preterm delivery, preeclampsia, foetal death, large for gestational age (LGA) and Caesarean as compared to women of average weight aged <35 years in this study from Finland; the combined effect of AMA and either overweight or obesity appeared to be a high risk state particularly for stillbirth and preterm delivery (35)

- Stillbirth
  - maternal overweight and obesity was a relevant modifiable factor contributing to more than 8000 stillbirths in all high income countries according to this systematic review (25)
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

- Preclampsia
  - the risk of preeclampsia and eclampsia increased significantly with increasing BMI and decreasing age; extremely obese teenagers were almost four times as likely to develop preeclampsia and eclampsia compared with non-obese women aged 20-24 years (adjusted odds ratio [95% confidence interval] = 3.79 [3.15-4.55]); teenagers were most at risk because of the combined effects of young age and obesity (36)

1d) Folic acid

This UK study of 466,860 women found that younger women were less likely to take folic acid supplements before pregnancy than older women; 6% of women aged under 20 and 40% of women aged between 35 and 39; the adjusted percentage of women taking folic acid supplements before pregnancy peaked at 38% in women aged 35–39 and was 31% in women aged 45 or older (37)

85% of 61,252 women in this Dublin cohort reported taking folic acid at some point during the peri-conceptional period; factors associated with taking the recommended amount of folic acid included early booking (<12 weeks) [OR: 1.24 (95% CI: 1.17-1.31)] and increasing maternal age (e.g. 30-34 years) [OR: 1.39 (95% CI: 1.30-1.48)]; factors associated with taking less than recommended or no folic acid included lower socio-economic status (e.g. unemployed) [OR: 0.63 (95% CI: 0.55-0.71)] and smokers [OR: 0.51 (95% CI: 0.47-0.55)] (38).

A series of systematic reviews identified the factors that are particularly associated with lower rates of use of folic acid supplements - most important of these is the link with unintended pregnancy, followed by age, socio-economic and ethnic group; women least likely to take folic acid are younger, lower income and have a lower educational level (39).

1e) Late antenatal care

Pregnant adolescents present to hospitals for prenatal care at a much more advanced gestational age compared with adults according to hospital records of 38,646 women - the mean gestational ages of the adolescent and adult groups at the first prenatal visit were 11.2 (range, 8-31) and 8.5 (range, 7-28) weeks, respectively (P < .001); the risks of preterm delivery and preeclampsia were significantly greater among the adolescent mothers (40).

The eight studies in this systematic review showed that low maternal age and low educational level were factors identified as individual determinants of inadequate use of prenatal healthcare (including late initiation); inadequate use was more likely among women who smoked during pregnancy (41).
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2. Socioeconomic status

Socioeconomic disadvantage has been associated with adverse birth outcomes and pregnancy complications.

- Adverse obstetric outcomes/pregnancy complications
  - a systematic review found 93/106 studies reporting a significant association between a socioeconomic measure and a birth outcome. Socioeconomic disadvantage was consistently associated with increased risk across socioeconomic measures, birth outcomes, and countries; many studies observed racial/ethnic differences in the effect of socioeconomic measures (42)
  - in the Generation R study, women with mid-low and low education had a higher risk of gestational hypertension than women with high education, which was largely due to higher body mass index (BMI) and blood pressure levels from early pregnancy (43)
  - employment status was significantly associated with many common risk factors for adverse pregnancy outcomes including maternal age, pre-pregnancy body mass index, periconceptional/first trimester smoking and alcohol consumption, and household income (44)
  - in the UK Millennium Cohort Study, based on 11,141 singleton children, adjustment for maternal smoking during pregnancy and breastfeeding removed the socioeconomic inequalities in common wheezing phenotypes (45)

- Low birth weight
  - adolescent mothers that lived in areas of high neighbourhood risk were significantly more likely to have infants of low birth weight than mothers living in areas of low neighbourhood risk (odds ratio = 1.55; 95% confidence interval, 1.25-1.93) (46)
  - in the Generation R study, infants of the lowest educated women had a statistically significantly lower birthweight than infants of the highest educated women, a large part of which was explained by pregnancy characteristics and lifestyle-related factors such as smoking (47)
  - the UK Millenium Cohort Study (18,492 mothers) found that women who had been looked after by local authorities were significantly less likely to be of a higher social class, live in a high-income household or have achieved a high level of education, and they were more likely to have a low-birthweight baby (48)

- Congenital anomalies
  - this UK audit found that compared with the least deprived areas, the most deprived areas had a 61% higher rate of live births (1.61, 1.21 to 2.15) and a 98% higher neonatal mortality rate (1.98, 1.20 to 3.27) associated with a congenital anomaly (49)
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- **Preterm birth**
  - this Swedish population-based study found that large geographical differences in rates of preterm birth remained across Sweden – differences in preterm birth rates also existed in the cities of Gothenburg and Stockholm at individual parish level (50)
  - a study using data from 12 European cohorts (included between 2434 and 99,655 pregnancies) identified similar educational differences in risk of preterm delivery in 8/12 cohorts with between 2.2 and 4.0 excess preterm deliveries per 100 singleton deliveries among the educationally most disadvantaged, and risk ratio between the lowest and highest education category varying from 1.4 to 1.9 [95% CI 1.2, 3.1] (51)
  - the odds of delivering a late and moderate preterm birth infant increased with decreasing levels of education (OR 1.60 (1.23 to 2.09) for degree level education compared to no qualifications P = 0.002). This is changed little after adjusting for maternal age and ethnicity. This variation was explained by: access to a car (OR 1.30 (1.03 to 1.66); smoking during pregnancy (OR 1.28 (1.01 to 1.63) and low levels of fruit and vegetable consumption (OR 1.26 (0.99 to 1.62)) (52)
  - in the Generation R study, the lowest-educated pregnant women had a statistically significant higher (nearly twofold) risk of preterm birth than the highest educated women; this elevated risk could largely be explained by pregnancy characteristics and lifestyle habits such as smoking (53)
  - from the national perinatal surveys in France, the main risk factors for preterm birth in 2010 included body mass index, the level of education completed (high school or less) and inadequate prenatal care (14)

- **Small for gestational age (SGA)**
  - the prevalence of SGA was around 6-13% higher in municipalities with an intermediate or high unemployment rate than municipalities with the lowest unemployment rate in this cross-sectional study from Finland (54)

- **Preeclampsia**
  - low maternal socioeconomic status is a strong risk factor for preeclampsia - women with low educational level were more likely to develop preeclampsia than women with high educational level in the Generation R study; only a small part of this association can be explained by the mediating effects of established risk factors for preeclampsia (55)
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2a) Alcohol

In a survey of 225 low-income, predominantly racial/ethnic minority pregnant women in a US urban area, 26% screened positive for alcohol risk - current smoking status (OR 2.9, p = 0.018, 95 % CI [1.2, 7.0]) and a history of marijuana use (OR 3.1, p = 0.001, 95 % CI [1.6, 6.2]) were the strongest predictors of alcohol risk status (56).

Data from 18,014 children born in France showed that compared to the native-born, migrant women had lower levels of tobacco smoking (8.8 vs. 21.9%) and alcohol use (23.4 vs. 40.7%), but not binge drinking (2.9 vs. 3.3%); migrant women have less favorable socioeconomic characteristics than native women but are generally less likely to use tobacco and alcohol in pregnancy (57).

2b) Smoking

- Prevalence
  - lower educated women were especially more likely to smoke (OR 11.3; 95% CI 7.6-16.8) or have passive smoking exposure (OR 6.9; 95% CI 4.4-11.0) in a Dutch cohort study of 6711 pregnant women (58)
  - in the Missouri Adolescent Female Twin Study, 35.2% of 1658 mothers reported any maternal smoking during pregnancy (MSP) and 21.9% reported MSP beyond the first trimester; neighborhood socioeconomic deprivation (SED) was associated with any MSP and MSP beyond the first trimester (59)
  - survey data from a German study of babies born between 1996 to 2002 (n=4818, older birth cohort) and from 2003 to 2012 (n=4434, younger birth cohort) showed that 19.9% of mothers of the older birth cohort had smoked during pregnancy, compared with 12.1% of mothers for the younger birth cohort; the probability of being exposed to tobacco smoke was twice as high for children whose mothers were aged <25 years at delivery compared to the children of older mothers for both cohorts, and children from socially deprived families were most affected by smoking behavior (60)
  - data on 337,876 women from the Medical Birth Register in Finland found that women living in municipalities defined as intermediately and highly deprived based on education were 53.7% and 71.5% respectively, more likely to smoke during pregnancy than women in the least deprived municipalities - smoking during pregnancy was 5.4-fold higher among women with the lowest as compared with highest individual SES (61)
  - the UK Millenium Cohort Study (18,492 mothers) found that women who had been looked after by local authorities were more likely to
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

- Adverse obstetric outcomes/pregnancy complications
  - In a study of 836 pregnant women in the Netherlands, factors predicting any adverse birth outcome for Western women included smoking during the first trimester; risk factors for high socio-economic status (SES) women were low family income, no daily intake of vegetables and a history of preterm birth; for low SES women risk factors appeared to include low family income, non-Western ethnicity and smoking during the first trimester
  - Children of women who smoke, are obese, or have a low SES during early pregnancy did not have an increased risk of esophageal atresia, in this case-control study of Swedish children born 1982-2004

- Preterm birth
  - For 3821 pregnant women of Dutch origin, the least educated women, who were more often smoking and exposed to environmental tobacco smoke, had a significantly higher risk of preterm birth (OR 1.95 [95% CI: 1.19–3.20]), LBW (OR 2.41 [95% CI: 1.36–4.27]) and SGA (OR 1.90 [95% CI 1.32–2.74]) than highly educated women - smoking explains to a considerable extent the association between lower maternal education and adverse perinatal outcomes
  - Data from 14,553 Dutch mothers revealed that in the lowest-educated group, the overall rate of smoking throughout pregnancy was 6 times as high as in the highest-educated group (18.7% versus 3.2%); prenatal tobacco smoke exposure was associated with increased risk of extremely preterm (<=28 completed weeks) and SGA infants
  - Prevalence data from the US showed that prenatal smoking among ages 15-24 is above 12%, with 20-24 year olds representing at least 35% of preterm births, LBW and sudden infant death (SIDS) cases; women with a high school education or less represented more than 50% of preterm and LBW births, and 44% of SIDS cases

- Birth defects
  - A literature review on risk factors for birth defects found there are few proven links between smoking and specific birth defects
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

- **Birth weight**
  - Maternal smoking had a negative association with birth weight which was highly variable between neighbourhoods and evidence of effect modification with neighbourhood-level factors; high dissemination area-level SES had a strong positive association with birth weight but the effect was moderated with increased cigarettes/day; conversely, heavy smokers showed the largest increases in birth weight with rising neighbourhood education levels (67).

**2c) Obesity**

Maternal age of 25-29 years (OR = 2.09 [1.13-3.87]; vs. 30-34 years) and high school level (OR = 2.22 [1.33-3.73]; vs. university level) were independently associated with prepregnancy obesity in a French cohort of 3368 mothers (68).

An analysis of 619,502 singleton births from maternity units in England found that women with an overweight or obese BMI accessed antenatal care later than women with a recommended BMI, and underweight women accessed care earlier; women with obesity were 42% more likely to access care in the third trimester compared with women with a recommended BMI (69).

Child birthweight did not associate with Index of Multiple Deprivation as an indicator of social deprivation in this UK cohort of 3240 deliveries; whilst maternal BMI positively predicts child BMI, this association occurred irrespective of markers of social disadvantage (70).

**2d) Folic acid**

Lower educated women were especially more likely to not take folic acid supplementation in this cohort study of 6711 pregnant women (OR 3.4; 95% CI 2.7-4.4) (58).

A literature review found a strong link between folic acid deficiency and an increased risk of congenital anomalies (15).

**2e) Late antenatal care**

Primary (OR = 6.30 [2.40-16.57]), junior high (OR = 2.89 [1.81-4.64]) and high school (OR = 1.86 [1.18-2.93]) education levels (vs. university level) and no attendance at antenatal classes (OR = 1.77 [1.16-2.72]), were independently associated with prepregnancy obesity in a French cohort of 3368 mothers (68).

A systematic review of the evidence for the determinants of prenatal healthcare use in high-income countries showed that living in neighbourhoods with higher rates of unemployment, single parent families, medium-average family incomes and low-educated residents were associated with inadequate use of prenatal care after 6 months (41).
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

Lower educated women were especially more likely to not attend antenatal classes (OR 4.5; 95% CI 3.5-5.8) in this cohort study of 6711 pregnant women (58).

A foreign maternal country of birth (OR 2.10; 95% CI 1.15-3.83), a total General Deprivation Index (GDI) >=3 (OR 4.40; 95% CI 2.36-8.21), the GDI criteria education (OR 4.02; 95% CI 2.00-8.08) and unemployment (OR 2.40; 95% CI 1.17-4.90) were good predictors for late initiation of antenatal care in this cohort study of 1115 women from Ghent, Belgium (71).

A study of 6822 pregnant women in New Zealand found that timeliness of lead maternity carer engagement is poorer for younger women (age <20 years 0.62, 0.41-0.94) and women living in more socioeconomically deprived areas (0.69, 0.52-0.92) (72).

Data on time of initiation of antenatal care from the Netherlands Perinatal Registry (2000-2008), which includes 96% of all pregnancies in the Netherlands, showed that neighbourhood socioeconomic status had no association with late initiation of antenatal care (73).

- Adverse obstetric outcomes/pregnancy complications
  - the Californian Birth Registry identified 1,775,234 births of which 90,327 (5.1%) were identified as late presenters to prenatal care - late presentation to care was associated with an increased risk of both neonatal death (0.78% vs 0.19% p <0.0001) and infant death (0.26% vs 0.08% p<0.0001) and cumulative death within the first year of life (1.0% vs 0.3 p<0.0001) for all pregnancies (74)
  - in this retrospective study of 59,487 women in Sheffield, pregnancy during the teenage years, higher parity, non-white ethnic background, unemployment and smoking were significantly associated with late access to antenatal services and poor fetal outcomes (P < 0.001); however, late booking per se did not predict adverse fetal outcomes, when socio-demographic factors were accounted for (75) – the paper concludes that “of the many complex sociocultural factors that influence the timing of maternal engagement with antenatal care, multiple deprivation and poor social support remain key factors”
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

Endnote database matrix showing the highly relevant papers with key information

This database can be obtained on request.
How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

References

How does smoking, alcohol use, folic acid, maternal obesity and timing of antenatal care in pregnancy vary by socioeconomic status or age of mother?

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