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# Low socioeconomic status increases effects of negative life events on antenatal anxiety and depression

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ABSTRACT

*Problem:* Low socioeconomic status and prior negative life events are documented risk factors for antenatal anxiety and depression, preterm birth and birth weight. We aimed to asses whether the adverse effects of prior negative life events increase with lower socioeconomic status and which aspects of socioeconomic status are most relevant.
*Methods:* We performed a population-based cohort study in the Netherlands including 5398 women in their first trimester of pregnancy. We assessed the number of negative life events prior to pregnancy, aspects of paternal and maternal socio-economic position and symptoms of anxiety and depression. Associations of the number of prior negative life events with anxiety, depression, low birth weight and gestational age were quantified.
*Findings:* The number of prior negative life events, particularly when they had occurred in the two years before pregnancy and maternal aspects of low socioeconomic status (educational level, unemployment and income) were associated with antenatal anxiety and depression. Furthermore, low socioeconomic status increased the adverse effects of prior negative life events. Obstetric outcomes showed similar trends, although mostly not statistically significant.
*Discussion:* Low socioeconomic status and prior negative life events both have an adverse effect on antenatal anxiety and depression. Furthermore, low socioeconomic status increases the adverse impact of prior negative life events on anxiety and depressive symptoms in pregnancy.
*Conclusion:* Interventions for anxiety and depression during pregnancy should be targeted particularly to unemployed, less-educated or low-income women who recently experienced negative life events.


Statement of significance

**Problem or issue**

Prior negative life events are a major risk factor for psychopathology during pregnancy. However, it is unknown whether the adverse effects of prior negative life events increase with lower socioeconomic status (SES) and which aspects of SES are most relevant.

**What is already known**

Low SES and prior negative life events both have an adverse effect on antenatal anxiety and depression.

**What this paper adds**

Evidence that prior negative life events, particularly when they had occurred recently and maternal aspects of low SES are associated with antenatal anxiety and depression. Additionally, low SES increases the adverse impact of prior negative life events on anxiety and depressive symptoms in pregnancy.

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## 1. Introduction

Symptoms of anxiety and/or depression are high frequency complications of pregnancy: 10–15% of all pregnant women experience symptoms of anxiety and/or depression.[1–3] Undergoing these symptoms during pregnancy is a major risk factor for preterm birth, low birth weight,[3,4] and postpartum psychopathology,[2,5] which in turn is associated with poor child outcomes, including insecure mother-child attachment,[6] and ultimately emotional, cognitive and behavioural problems in childhood and adolescence.[2,7]

Therefore, to target and design interventions it is essential to have a clear understanding of the determinants of depression and anxiety during pregnancy. A well-known general risk factor for depression is the experience of a negative life event.[5,8] Indeed, negative life events experienced before pregnancy have shown to be a strong predictor of depression during pregnancy and possibly also anxiety.[5,8]

However, the relevance of the timing of events is still unclear.[5,8,9] Earlier research among adults from the general population showed that the association between prior negative life events and psychopathology is generally stronger when the life event happened more recently.[10,11] A different pattern is observed for childhood traumas of which the effects show substantial latency, i.e. they strongly link to an increased risk of psychopathology in adulthood.[12,13] Whether these time relationships generalize to pregnancy is however unknown.

Not only prior negative life events, but also low socioeconomic status (SES) has been associated with depression and anxiety. The latter has been shown in both general population as well as in postpartum women.[14,15] Therefore, low SES may as well be a risk factor for antenatal anxiety[9] and depression.[5] Yet, the literature is still inconclusive about which aspects of SES, paternal and maternal, play a role.[8]

Low SES and negative life events before pregnancy are not only associated with anxiety and depression during pregnancy, but may also have an adverse effect on birth weight and preterm birth which underscores the importance of their study.[16–18]

As low SES and prior negative life events are likely to be interrelated and because women with low SES may have less mental resources and may be less able to cope with negative life events earlier in life it may well be that these risk factors interact. Therefore, it can be hypothesized that low SES women are more vulnerable to the effects of negative life events on anxiety, depression, and low birth weight or preterm birth compared to their peers with normal or high SES. To date this is unknown.

To our knowledge, the present study is the first to investigate the associations of prior negative life events in different periods in life and aspects of low SES with symptoms of antenatal anxiety and depression as well as low birth weight or prematurity and their potential interaction.

## 2. Methods

### 2.1. Study design

This study was carried out using the baseline measurements of the Pregnancy, Anxiety and Depression (PAD) study.[19] This population-based prospective cohort study was designed to investigate symptoms of and risk factors for antenatal and postnatal anxiety and depression.

### 2.2. Population

All pregnant women in their first trimester of pregnancy visiting a total of 109 collaborating primary obstetric care centres and 9 hospitals in 83 cities (47 rural; 36 urban) in the Netherlands were invited to participate. Midwives and gynaecologists invited all patients during their first or second visit in their clinic and provided them with information about the study. If the patients agreed with participation, they obtained written informed consent and informed the researchers about participation, whereupon the researchers sent the online questionnaires.[19] Unfortunately, due to logistical reasons it has been impossible to determine how many women have actually been invited and consequently to determine the exact participation rate. Because the number of participating women was considerably lower than expected we conducted a survey among participating midwives and gynaecologists. The results indicated that the vast majority of them were unable to hand out the forms to all visiting women due to time constraints and that they had not specifically invited women they suspected to have risk factors, psychopathology or other conditions. Therefore, we have no reason to believe that responders and non-responders differed in any considerable way with respect to characteristics relevant to the present study.[19]

### 2.3. Procedures

Written informed consent was obtained. After the baseline questionnaires at the end of the first trimester, follow-up assessments took place at the end of the second and third trimesters, as well as six weeks and three and six months postpartum. Women were recruited from May 2011 to September 2014. By the end of that period, 6481 women agreed/consented to participate of whom 5398 (83,2%) had completed baseline assessments.

### 2.4. Measurements

The Spielberger State Trait Anxiety Inventory (STAI) was used to assess the level of anxiety.[20] We used the 6-item short-form to measure state anxiety which produces scores similar to those obtained using the full-form.[20] The 10-item Edinburgh Postnatal Depression Scale (EPDS) was used to measure depression symptom levels.[21] This version of the EPDS has shown to be valid during pregnancy.[22]

The Negative Life Events Questionnaire (NLEQ) was used to assess adverse life events prior to pregnancy.[23] The mentioned life events were: divorce (parent, self or child), new relationship, moving, long-term and/or severe illness (parent, sibling, partner, self, child or another important person (e.g. friend, in-laws, confidential advisor)), death (parent, sibling, partner, child or another important person), severe psychiatric problems (parent, sibling, partner, child, self or another important person), suicide attempt (parent, sibling, partner, child, self or another important person), family violence, alcohol/drug abuse within family or relationship, being victim of a crime, victim of a severe accident, victim of sexual abuse, victim of assault, having an unwanted pregnancy. We distinguished different periods in life: (1) from birth until the age of 16 (childhood trauma); (2) from the age of 16 until two years before pregnancy; (3) the two years before pregnancy.

SES was measured using a questionnaire based on the Leidsche Rijn study.[24] Five aspects of SES were documented: educational level (self), educational level (partner), occupation (self), occupation (partner) and their annual gross family income. Educational levels were defined as the highest completed education, divided into three categories; low (elementary and lower tracts of secondary education), intermediate (higher tracts of secondary education and intermediate vocational education), and high (higher vocational education and university). Family annual gross income was divided into low (€0–€30,999), modal (€31,000–€59,999), and high (€60,000 or more).

All questionnaires were administered online.

Obstetric outcomes were obtained for a part of the study population. While we requested all midwives and gynaecologists in our study to provide birth records including data on birth weight and gestational age of participating women, this request was complied with for only 2867 (53.1%) women.

### 2.5. Multiple imputation and statistical analysis

To avoid risk of bias and loss of statistical power in complete case analyses, missing data was imputed. We used multiple imputation by chained equations under the assumption that data was missing at random (MAR) or completely at random (MCAR).[25] Twenty datasets were imputed and combined according to Rubin's rules.[26] The percentage of missing data was approximately 22 (range: 15%; number of life events — 38%; family annual gross income). The missing data mechanism was studied for each of the variables, by predicting missingness of each of these variables from the other variables in the imputation model using multivariable logistic regression analyses. These analyses showed explained variances ranging from 0.6% to 27.1% (Nagelkerke's $R^2$), implying that data were at least partly missing at random, and consequently, multiple imputation may have minimized bias. The final imputation model included those variables that predicted the value of the incomplete variable and whether the incomplete variable was missing or not. Because the MAR nor the MCAR assumption can be proved we added complete case analyses as a sensitivity analysis. Because obstetric outcomes were only available in 53.1%, we did not impute birth weight and gestational age to the total population but rather performed complete case analyses.

We calculated descriptive statistics for maternal age, STAI- and EPDS-scores, number of negative life events, SES, and obstetric outcomes. Measurements of symptoms of anxiety and depression exhibiting skewed distributions were transformed using the natural logarithms, before further analyses were conducted to satisfy the prerequisite assumptions of normality. To allow for valid comparison of effect sizes between the associations with anxiety, depression, birth weight, and gestational age we created Z-scores for the corresponding variables.

Using multivariable linear regression we assessed which aspects of SES were associated with levels of anxiety or depression. To facilitate comparison of effects of high numbers of life events with low SES, we inverted the SES scores: high scores represent low SES and vice versa. Statistically significantly associated aspects of SES were equally weighted combined into an aggregated variable, which was used in following analyses. To correct for shared variance between anxiety and depression, we adjusted the analyses of anxiety for depression, and vice versa. Subsequently, we repeated these analyses for birth weight and gestational age.

Hereafter, using multivariable linear regression we assessed associations of anxiety and depression as dependent variables with the number of negative life events categorized by period in life as independent variables. Furthermore, we researched which of the associations between number of life events and both anxiety and depression were modified by SES. This was done by adding an interaction term SES*number of life events as an independent variable and testing its statistical significance.

Additionally, we quantified the associations for the available obstetric outcomes (birth weight, gestational age, and birth weight corrected for gestational age by adding birth weight as independent variable). We repeated earlier analyses to assess the associations between the number of negative life events, categorized by period in life with obstetric outcomes, and which of these associations were modified by SES.

Multiple imputation and analyses were performed with SPSS 22 (IBM, USA). The level of statistical significance was conventionally set at 0.05, two-sided.

### 2.6. Ethics

The PAD-study was approved by the medical ethical review board of (identifying information deleted).

## 3. Results

### 3.1. Descriptive statistics

Characteristics of the study participants after imputation of missing data are presented in Table 1. Most women and their partners were intermediate or highly educated, were employed, and had a modal family income.

**Table 1**
Characteristics of the study participants N = 5398.

| | |
|---|---|
| Age, mean years (SD) | 30.5 (4.4) |
| Anxiety (STAI) score, median (IQR) | 33.3 (10.0) |
| Depression (EPDS) score, median (IQR) | 4.0 (4.0) |
| Number of negative life events, median (range); N (%) >1 | |
| - Age 0–16 years | 1 (0–12); 1525 (28.3) |
| -Age 16–two years before pregnancy | 2 (0–15); 3671 (68.0) |
| -Last two years before pregnancy | 1 (0–11); 1646 (30.5) |
| Education, self N (%); partner N (%) | |
| -Low | 220 (4.1); 528 (9.8) |
| -Intermediate | 1886 (34.9); 2272 (42.1) |
| -High | 3292 (61.0); 2598 (48.1) |
| Employed, self N (%), partner N (%) | 4844 (89.8); 5221 (96.7) |
| Family annual gross income, N (%) | |
| -Low (€ 0–€ 30.999) | 873 (16.2) |
| -Modal (€ 31.000–€ 59.999) | 2593 (48.0) |
| -High (€ 60.000 or more) | 1932 (35.8) |
| | |
| Birth outcomes, N = 2687 | |
| Birth weight, mean grams (SD) | 3479 (602) |
| Gestational age, mean weeks (SD) | 39.3 (3.0) |

SD — standard deviation, STAI — Spielberger State Trait Anxiety Inventory (min–max 20–80), EPDS — Edinburgh Postnatal Depression Scale (min–max 0–30), IQR — interquartile range.

### 3.2. Associations of aspects of SES with anxiety, depression, and birth outcomes

Significant associations were found between educational level of the woman (B 0.088, 95%CI 0.013–0.162, p = 0.021), employment status of the woman (B 0.205, 95%CI 0.146–0.264, p < 0.001), and family income (B 0.107, 95%CI 0.040–0.174, p = 0.002) with symptoms of anxiety. Except for educational level (B 0.010, 95% CI −0.070 to 0.089, p = 0.806), comparable associations were seen with symptoms of depression (employment status of the woman: B 0.210, 95%CI 0.151–0.269, p < 0.001, family income: B 0.134, 95%CI 0.073–0.195, p < 0.001). Neither partners' educational level nor his employment status was associated with maternal anxiety or depression.

Equal trends were observed for the adverse effects of aspects of low SES on birth weight and gestational age. However, none of these results were statistically significant (p = 0.101–832).

### 3.3. Associations of aspects of prior negative life events with anxiety and depression, and effect modification by SES

As presented in Table 2, the number of prior negative life events was almost equally associated with anxiety and depression. Strongest associations were observed for events that had happened in the two years before pregnancy, which were twice as strong as between age 16 and two years before pregnancy.

Furthermore, these associations were statistically significantly modified by SES, i.e. became larger with lower levels of SES. This regarded both anxiety as depression, except for the events that occurred between birth and the age of 16 years. Size of the effect modification by SES increased with time: adverse effects of negative life events which happened in the last two years before pregnancy were more strongly modified by SES than those which happened earlier in life.

### 3.4. Associations of prior negative life events with obstetric outcomes

Results of the multivariable linear regression analyses to assess the adverse effects of prior negative life events on obstetric outcomes are presented in Table 3. Although the majority of the associations and effect modifications were not statistically significant (p = 0.034–0.854), the observed trends were equal to the associations with symptoms of anxiety and depression, i.e. life events were associated with lower birth weight and lower gestational age. The strongest associations and effect modifications were observed for events that had happened in the two years before pregnancy, followed by childhood traumas (age 0–16 years) and negative life events that occurred between 16 years age and two years before pregnancy.

Correction for shared variance (between anxiety and depression, and between birth weight and gestational age) did not considerably affect the results. Results of complete case analyses were not notably different from imputed data analyses.

## 4. Discussion

In this large population based study we demonstrated that the number of prior negative life events is associated with symptoms of anxiety and depression early in pregnancy. These associations increase when the events happened more recently, except for childhood traumas. Furthermore, we found that aspects of SES: low maternal educational level, maternal unemployment, and low family income are not only directly associated with anxiety and depression, but also increase adverse effects of negative life events. Additional analyses on obstetric outcomes showed comparable trends, although mostly not statistically significant.

Our finding that prior negative life events are associated with antenatal depression is consistent with present literature.[5,8] As we hypothesized, anxiety is equally associated as depression. Furthermore, we demonstrated that these associations are stronger when the event happened more recently, except for childhood traumas; this is consistent with literature about these associations among non-pregnant women.[10,11] However, subjective impact of the events was not assessed, so differences in associations may not be completely explained by temporality. Indeed, a life event during childhood may have greater emotional impact than when a comparable event happened during adulthood.

The associations of low SES with antenatal depression and anxiety have been shown earlier,[5,9] although literature was conflicting about which aspects of SES play a role. Lancaster

**Table 2**
Associations of number of life events per life period with anxiety and depression during pregnancy and effect modification by SES (N = 5398).

| Number of negative life events per life period | Associations with anxiety (STAI) | | | | Associations with depression (EPDS) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Effect modification | | | | Effect modification | |
| | B (95% CI) | p-Value | B (95% CI) | p-Value | B (95% CI) | p-Value | B (95% CI) | p-Value |
| No. of life events (age 0–16 years) | 0.027 (0.059–0.096) | <0.001 | 0.067 (0.046–0.087) | | 0.069 (0.056–0.082) | <0.001 | 0.119 (0.063–0.175) | |
| SES score | 0.090 (0.070–0.110) | <0.001 | 0.064 (0.040–0.088) | | 0.219 (0.165–0.273) | <0.001 | 0.186 (0.117–0.255) | |
| Life events * SES | | | 0.017 (0.009–0.026) | <0.001 | | | 0.022 (−0.002 to 0.045) | 0.074 |
| No. of life events (age 16–two years before pregnancy) | 0.022 (0.018–0.025) | <0.001 | 0.052 (0.035–0.069) | | 0.057 (0.047–0.066) | <0.001 | 0.127 (0.082–0.172) | |
| SES score | 0.106 (0.087–0.125) | <0.001 | 0.070 (0.043–0.096) | | 0.260 (0.207–0.313) | <0.001 | 0.177 (0.102–0.251) | |
| Life events * SES | | | 0.013 (0.006–0.019) | <0.001 | | | 0.029 (0.011–0.047) | <0.001 |
| No. of life events (last two years before pregnancy) | 0.034 (0.029–0.040) | <0.001 | 0.094 (0.065–0.122) | | 0.084 (0.069–0.100) | <0.001 | 0.195 (0.119–0.270) | |
| SES score | 0.096 (0.076–0.116) | <0.001 | 0.062 (0.034–0.090) | | 0.236 (0.181–0.291) | <0.001 | 0.173 (0.098–0.247) | |
| Life events * SES | | | 0.025 (0.013–0.036) | <0.001 | | | 0.046 (0.015–0.076) | <0.001 |

Multivariable linear regression analyses. Symptoms of anxiety and depression were assessed using STAI- and EPDS-questionnaires and were subsequently standardized by calculating Z-scores. Educational level and employment status of the woman and family income were equally weighted combined to the variable SES score. SES scores were inverted: a high score represents a low SES and vice versa.
CI — confidence interval, EPDS — Edinburgh Postnatal Depression Scale, SES — socioeconomic status, STAI — Spielberger State Trait Anxiety Inventory.

**Table 3**
Associations of number of life events per life period with obstetric outcomes and effect modification by SES (N = 2687).

| Number of negative life events per life period | Associations with birth weight (grams) | | | | Associations with gestational age (weeks) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Effect modification | | | | Effect modification | |
| | B (95% CI) | p-Value | B (95% CI) | p-Value | B (95% CI) | p-Value | B (95% CI) | p-Value |
| No. of life events (age 0–16 years) | −0.024 (−0.049 to 0.002) | 0.070 | −0.129 (−0.244 to −0.015) | | −0.002 (−0.027 to 0.022) | 0.844 | −0.050 (−0.161 to 0.062) | |
| SES score | −0.71 (−0.170 to 0.027) | 0.155 | −0.004 (−0.130 to 0.121) | | −0.029 (−0.139 to 0.081) | 0.604 | 0.001 (−0.142 to 0.144) | |
| Life events * SES | | | −0.046 (−0.095 to 0.003) | 0.064 | | | −0.021 (−0.068 to 0.026) | 0.391 |
| No. of life events (age 16–two years before pregnancy) | −0.010 (−0.023 to 0.020) | 0.330 | −0.053 (−0.156 to 0.050) | | −0.003 (−0.021 to 0.015) | 0.732 | 0.005 (−0.093 to 0.103) | |
| SES score | −0.087 (−0.185 to 0.011) | 0.080 | −0.036 (−0.194 to 0.121) | | −0.030 (−0.138 to 0.078) | 0.579 | −0.040 (−0.197 to 0.117) | |
| Life events * SES | | | −0.018 (−0.060 to 0.024) | 0.405 | | | 0.003 (−0.036 to 0.043) | 0.867 |
| No. of life events (last two years before pregnancy) | −0.035 (−0.067 to 0.003) | 0.034 | −0.211 (−0.380 to −0.41) | | 0.003 (−0.027 to 0.033) | 0.854 | −0.138 (−0.290 to 0.015) | |
| SES score | −0.075 (−0.173 to 0.024) | 0.139 | 0.027 (−0.106 to 0.161) | | −0.032 (−0.142 to 0.078) | 0.567 | 0.049 (−0.104 to 0.203) | |
| Life events * SES | | | −0.073 (−0.143 to −0.003) | 0.040 | | | −0.058 (−0.120 to 0.003) | 0.062 |

Multivariable linear regression analyses. Birth weight and gestational age were standardized by calculating Z-scores. Educational level and employment status of the woman and family income were equally weighted combined to the variable SES score. SES scores were inverted: a high score represents a low SES and vice versa.
CI — confidence interval, SES — socioeconomic status.

et al. found inconsistent results for low educational level, unemployment and low income with antenatal depression in their multivariable meta-analysis.[8] In our sample, we saw strong and significant associations for maternal unemployment and low family income with both anxiety and depression and additionally low maternal educational level with anxiety. Remarkably we did not see any association for educational level and employment status of the partner. Although maternal and paternal anxiety and depression frequently correlate,[27] we did not find any literature on the association of paternal educational level and employment status on maternal anxiety or depression, but apparently these aspects of family SES have no impact on maternal psychopathology during pregnancy.

Furthermore, as we hypothesized, prior negative life events seem to have a greater impact on women when their SES is lower. This more than additional adverse effect of a low SES on the known effect of negative life events on anxiety and depression during pregnancy was never demonstrated before. Only Rich-Edwards et al. performed a study to assess the association of a history of abuse with depression during pregnancy in both a rich and a poor part of the city Boston.[28] Despite the higher prevalence of abuse and depression in the more disadvantaged cohort, the associations of abuse with risk of depression were similar in their two cohorts. In our cohort, we found substantial and statistically significant effect modification of the associations of negative life events with both anxiety and depression during pregnancy by SES. The magnitude of the effect modification by SES is larger on the events that have happened more recently. Apparently, low SES has a larger effect on the impact of recent events than to childhood traumas.

Associations of prior negative life events with adverse obstetric outcomes were observed in large population based studies (low birth weight: N = 9350, preterm birth: N = 17,285).[16,17] In our study we found comparable trends, although not statistically significant, possibly due to the smaller sample size. This as well applied for the adverse effect of low SES on obstetric outcomes.[18] To our knowledge, effect modification of adverse effects of negative life events on obstetric outcomes by SES was never studied before. Although most results were not statistically significant, our analyses showed clear trends. Comparable to the effect of life events on symptoms of anxiety and depression, the magnitude of the effect modification by SES may be larger on the events that have happened more recently.

Findings of this study should be interpreted in view of some limitations. First, life events were documented using retrospective self-report checklists, which may have been prone to recall bias through its potential link with symptoms at the time of the assessments. Second, measurements of symptoms of anxiety and depression were based on self-report questionnaires. No diagnosis could be made using these questionnaires, although both STAI and EPDS questionnaires are commonly used in identifying symptoms of psychopathology.[20,22] Third, as mentioned in the methods paragraph, it has been impossible to determine the exact participation rate. However, the results of our survey among participating midwives and gynaecologists indicated that they had not specifically invited women they suspected to have risk factors, psychopathology or other conditions. Therefore, we have no reason to believe that responders and non-responders differed in any considerable way with respect to characteristics relevant to the present study.[19] Fourth, as mentioned earlier, while we requested all participating midwives and gynaecologists to provide birth records including data on birth weight and gestational age of participating women, this request was complied with for only 2867 (53.1%) women. A major asset of this study is the inclusion of a large population based prospective sample, which enhanced the study's precision and generalizability. The inclusion of women living in a large part of the Netherlands, in both rural and urban areas, further adds to the generalizability of our results.

Implication of these findings may be that more attention should be paid to the assessments of both prior negative life events and SES in designing and implementing psychosocial interventions for pregnant women. Aspects of SES that are particularly relevant are low maternal educational level, maternal unemployment, and low family income. Interventions are likely most cost-effective when targeted at low SES women with a history of multiple life events, in particular those who have experienced recent events. Ultimately, preventing or reducing psychopathology during pregnancy may

prevent emotional, cognitive and behavioural problems in the offspring.[2,7]

## 5. Conclusion

Low SES increases the adverse impact of prior negative life events on anxiety and depressive symptoms in pregnancy. Interventions for anxiety and depression during pregnancy should be targeted particularly to unemployed, less-educated or low-income women who recently experienced negative life events.

## Conflict of interest

The authors have no conflict of interest to declare.

## Ethical statement

This study received full ethical approval prior to commencement.

Name of Ethics Committee: Medical Ethical Review Board of the University Medical Center Groningen.

Approval Number: METc2009.235.

Approval Date: 16/11/2009.

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