Predictors of persistent maternal depression trajectories in early childhood: results from the EDEN mother–child cohort study in France

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Abstract

Background

Maternal depression in the pre and postpartum period may set women on a course of chronic depressive symptoms. Little is known about predictors of persistently elevated depressive symptoms in mothers from pregnancy onwards. The aims of this study are to determine maternal depression trajectories from pregnancy to the child's fifth birthday and identify associated risk factors.

Methods

1807 mothers from the EDEN mother-child birth cohort study based in France (2003-2011) were followed from 24-28 weeks of pregnancy to their child's fifth birthday. Maternal depression trajectories were determined with a semi parametric group-based modeling strategy. Socio demographic, psychosocial and psychiatric predictors were explored for their association with trajectory class membership.

Results

Five trajectories of maternal symptoms of depression from pregnancy onwards were identified: no symptoms (60.2%); persistent intermediate-level depressive symptoms (25.2%); persistent high depressive symptoms (5.0%); high symptoms in pregnancy only (4.7%); high symptoms in the child's preschool period only (4.9%). *Socio-demographic predictors* associated with persistent depression were non-French origin; *psychosocial predictors* were childhood adversities, life events during pregnancy and work overinvestment; *psychiatric predictors* were previous mental health problems, psychological help, and high anxiety during pregnancy.

Conclusions

Persistent depression in mothers of young children is associated to several risk factors present prior to or in pregnancy, notably anxiety. These characteristics precede depression trajectories and offer a possible entry point to enhance mother's mental health and reduce its burden on children.

Introduction

Depression is a common mental health problem among women of childbearing age, with prevalence rates ranging from 10 to 32% (Ertel *et al*. 2011; Wang *et al.* 2011). The impact of depression is significant not only for women's quality of life (Darcy *et al.* 2011), but also for their children's developmental outcomes (Ertel *et al.* 2011; Turney, 2012). Most information on the occurrence of maternal depression comes from studies conducted during the perinatal period (pregnancy to 12 months after delivery) (Horwitz *et al.* 2009), although symptoms may persist or reemerge later (Essex *et al.* 2001; Goodman, 2007), setting women on a course of chronic depressive symptoms which have especially deleterious consequences for children (Connelly *et al.* 2010; Fihrer *et al.* 2009; Turney, 2012).

Risk factors for maternal depression (such as socio-economic disadvantage, a prior history of mental disorders, stressful life events, poor social support, domestic violence, and pregnancy/ obstetric complications) have been well examined in the perinatal period (Koleva *et al.* 2011; O'Hara & McCabe, 2013; Seimyr *et al.* 2013). Yet, little is known about predictors of persistent depression in mothers. With few exceptions (Giallo *et al.* 2014; Horwitz *et al.* 2009; Seto *et al.* 2005; Skipstein *et al.* 2010; 2012; Wang *et al.* 2011; Woolhouse *et al.* 2014), longitudinal studies examining chronic mental health difficulties in women beyond the second-year postpartum are scarce. These studies found that depressive symptoms are disproportionately likely to persist in women who are young, belong to an ethnic minority group, are unemployed, have low social support, experience high parenting stress, and stressful life events. However, most initial data collection was conducted 10 to 20 years ago and there is need for contemporary data on this topic. With the exception of the work by Woolhouse *et al* (2014), none of these studies included depressive symptoms occurring in pregnancy, even though these are prevalent (12.4%) and associated with risk of later depression (Banti *et al.* 2011; Gaillard *et al.* 2014; Vliegen *et al.* 2014).

In order to gain better understanding of women's longitudinal patterns of depression and associated early risk factors we focused on antenatal predictors for persistent maternal depression

4

from pregnancy onwards. We used data from a community-based sample of mothers followed from pregnancy up to when the child was five years of age to 1) determine symptom trajectories; 2) identify socio-demographic, psychosocial and psychiatric predictors of maternal depression trajectories present before or during pregnancy.

Methods

Participants

Data for this study come from the EDEN mother-child study, set up to assess the pre- and postnatal nutritional, social, and environmental determinants of infant and child development and health (Drouillet *et al.* 2009). Pregnant women were recruited before 24 weeks of gestation from two maternity wards (Poitiers and Nancy University hospitals in France) between September 2003 and January 2006. Exclusion criteria were multiple pregnancies, history of diabetes, inability to speak and read French or plans to move out of the study region within the next 3 years. Among eligible women, 55% agreed to participate. Of the 2002 women recruited during pregnancy, birth data were available for 1899 mother-infant pairs. From pregnancy onwards, mothers and children were followed nine times (pregnancy, birth, 4, 8, 12, 24 months, 3, 4 and 5 years) via face-to-face or self-completed questionnaires completed by the mothers. Data on the child's birth characteristics were collected directly from medical records.

By the year 5 follow-up, data on maternal depression were available for 1190 participants. Attrition rates were highest for mothers who were of non-French origin, young, had low educational level, and at baseline were single, unemployed, had financial difficulties or experienced other life events, had low social support, reported childhood adversity, used tobacco, had a history of mental health problems. The study was approved by the Comité Consultatif de Protection des Personnes dans la Recherche Biomedicale (Ethics Committee, Kremlin Bicêtre Hospital) and by the Commission Nationale de l'Informatique et des Libertés (National Committee for Processed Data and Freedom

5

(CNIL)). Written consent was obtained from the mother for herself at inclusion and for her newborn child after delivery.

<u>Measures and procedures</u>

Maternal symptoms of depression

Depressive symptoms during pregnancy and at 3 and 5 years follow-ups were assessed using the Center for Epidemiological Studies Depression (CES-D) questionnaire (Radloff, 1977). This previously validated 20-item questionnaire measures the number of depressive symptoms over the past week (score ranging 0-60) (Fuhrer & Rouillon, 1989; Joiner *et al.* 2005). A threshold of ≥16 is commonly used to identify individuals at risk for clinical depression.

Depressive symptoms during the first year after the child's birth (4, 8 and 12 months postpartum) were assessed using the Edinburgh Postnatal Depression Scale (EPDS), a 10-item questionnaire designed to detect postnatal depression (score ranging 0-30) (Cox *et al.* 1987). In this study we used the cut-off ≥12, which has been recommended for the French translation and has demonstrated its validity for research purposes (Guedeney & Fermanian, 1998; Teissedre & Chabrol, 2004).

To identify trajectories of maternal depressive symptoms we needed to meaningfully combine the scores of both instruments, which have different possible symptom severity score ranges. Thus, the scores for each instrument were standardized to t-scores (M = 50, SD =10), which allowed us to study them jointly as continuous measures.

Predictors

Based on the scientific literature we identified several socio demographic, psychosocial and psychiatric characteristics potentially associated with maternal depression trajectories.

Socio demographic characteristics were: study center (Poitiers vs. Nancy), age (dichotomized at the sample mean <30 vs.≥30 years), country of birth (France vs. other), family situation (single vs.

6

married/cohabitating), number of children, maternal educational level (< 12 vs. ≥12 years), maternal employment at the beginning of pregnancy (yes vs. no), partner's educational level (< 12 vs. ≥12 years), partner's employment (yes vs. no), financial difficulties (any of the following (yes vs. no); difficulties to feed or clothe the family, difficulties to pay the rent, heating or electricity, regular overdraft of bank account, subsided health coverage). *Psychosocial* characteristics included negative life events that were assessed using a 17-item measure including major life events such as moving house, separation or divorce, death or serious illness of a close friend or family member, or legal troubles. Endorsed items were totaled to create an overall score (hypothetical range 0-17). As a large part of the sample (80%) did not experience any events, scores were dichotomized for any life event occurrence (yes vs. no). Work related stress and work-related over commitment were measured with the Effort-Reward Imbalance (ERI) scale (Siegrist *et al.* 2004). The standard ERI questionnaire comprises 46 items measuring efforts (including work obligations and physical demands of the job) and rewards (including financial compensation, job security, personal and social recognition). Responses for each scale are summed and a categorical score for Effort-reward imbalance is calculated (yes vs. no). The over-commitment scale includes items such as "As soon as I get up in the morning I start thinking about work problems", and "People close to me say that I sacrifice too much for my job." These are scored on a four-point response scale, giving a range from 6 to 24; this scale is divided into the upper third of the distribution versus the rest (yes vs. no). Additional psychosocial risks included at least one maternal childhood adversity experienced prior to age 18 (material deprivation, parental conflict or violence, child abuse or neglect, placement out of home; yes vs. no), partner's substance use (tobacco, alcohol or cannabis use; yes vs. no), social support (yes vs. no). *Psychiatric* characteristics included: childhood behavior problems (yes vs. no), previous mental health problems (yes vs. no), pre-pregnancy mental health treatment (yes vs. no), pre-pregnancy substance use (tobacco, alcohol or cannabis use; yes vs. no), and anxiety in pregnancy (STAI score (Spielberger *et al.*, 1983) dichotomized at the 80th centile, <17 vs. ≥18).

Statistical analyses

Our aim was to identify trajectories of maternal depressive symptoms and associated predictors. We conducted a trajectory analysis, a semi parametric group-based modeling strategy used to identify homogeneous latent trajectory classes based on longitudinal data (Nagin, 1999, 2005). Using the six scores of maternal depression available to us, we modeled maternal trajectories of depression using growth trajectory models (PROC TRAJ in SAS 9.3) under the censored normal distribution (Jones *et al.* 2001). Missing data were handled by PROC TRAJ under the missing-at-random assumption, where individuals with missing information were assigned to their most likely group (Jones & Nagin, 2007). The number and shapes of latent trajectories were determined using the Bayesian information Criteria (BIC) and refined by setting the trajectories' order (i.e. linear, quadratic, cubic). Using backward elimination of higher-order trajectories, a more parsimonious model was maintained whenever a higher-order growth coefficient did not reach statistical significance and the BIC value decreased. To define a good model, average posterior probabilities of trajectory membership should be at least equal to 0.7 for all groups (Nagin, 2005).

In the second stage of analysis, we used multinomial logistic regression analyses to test associations between predictors and trajectory groups (using the never depressed group as the reference). Variables were included in the final multivariate model if they were associated with class membership at p< .10 in bivariate logistic regression models. Our antenatal predictors of maternal depression trajectories were assessed at study baseline, resulting in very few covariates with missing data levels of >2% (overall: 2.23%). Exceptions were partner's substance abuse (9.5% of data missing), work related stress and work-related over commitment (4.1% and 4.0% missing, respectively). Analyses were conducted with SPSS version 20.

Results

Maternal depression trajectories

The study sample included 1807 mothers with sufficient data to estimate depression trajectories.

The optimal number of maternal depression trajectories in our study was five. Average posterior probabilities of group membership were above 0.80 for all groups. The five trajectories of maternal depressive symptoms were as follows (**Figure 1**): 60.2% (*n*=1087) of mothers had *no symptoms*; 4.7% (*n*=85) had *high symptoms in pregnancy only*; 4.9% (*n*=89) had *high symptoms in the child's preschool period only*; 25.2% (*n*=456) had persistent *intermediate-level symptoms* and 5.0% (*n* =90) of mothers had *persistent high-level symptoms*. As expected, participants' symptoms at each wave of measurement were associated with the trajectory of depressive symptoms. Scores for persistent high-level symptoms were well above clinical cut-off scores for both depression measures (**Table 1**).

Sample descriptives

Table 2 presents participants' sociodemographic, psychosocial and psychiatric characteristics. Mothers were on average 30 years old at the time of the child's birth, mostly of French origin (95.7%), 92.7% were married or cohabitating and had on average 1 child. 54.2% had at least 2 years of higher education, 83.9% were in paid employment at the beginning of pregnancy, 12.7% reported financial difficulties, 19.8% experienced at least one negative life event during pregnancy and 29.3% reported childhood adversities. 14.6% reported work stress and 32.5% work overinvestment. 53.0% had a partner who used a psychoactive substance (mostly tobacco), while 3.8% experienced a lack of social support. Seven percent reported childhood behaviour problems and 10.7% previous mental health problems. 9.6% received pre-pregnancy mental health treatment, 36.9% reported pre-pregnancy substance use and 21.1% of mothers had symptoms of anxiety.

Predictors of maternal depression trajectories

Most socio demographic, psychosocial and psychiatric characteristics were associated with depression trajectories, with the exception of maternal age and family situation **(Table 2).**

Table 3 presents the results (adjusted ORs) of multivariate regression analyses examining predictors of maternal depression trajectory. Compared to the *no symptoms* group, variables that were associated with depressive symptoms in *pregnancy only* included non-French origin (OR 4.94, 95% CI

1.35-18.07), experience of childhood adversities (OR 2.49, 95% CI 1.33-4.68), lack of social support (OR 4.31, 95% CI 1.52-12.25), history of mental health problems (OR 2.31, 95% CI 1.02-5.22), pre-pregnancy substance use (OR 2.27, 95% CI 1.17-4.39) and anxiety during pregnancy (OR 11.97, 95% CI 6.42-22.31). Depressive symptoms *in the child's preschool period only* were associated with partner's low educational level (OR 1.99, 95% CI 1.09-3.65), pre-pregnancy mental health treatment (OR 2.58, 95% CI 1.18-5.65) and anxiety during pregnancy (OR 3.89, 95% CI 2.17-6.99). Persistent *intermediate-level depressive symptoms* were associated with the experience of life events during pregnancy (OR 1.47, 95% CI 1.03-2.09), work overinvestment (OR 2.04, 95% CI 1.49-2.78), pre-pregnancy mental health treatment (OR 1.78, 95% CI 1.09-2.93) and anxiety during pregnancy (OR 3.33, 95% CI 2.35-4.71). Finally, *persistent high depressive symptoms* were associated with non-French origin (OR 5.92, 95% CI 1.86-18.86), childhood adversities (OR 4.09, 95% CI 2.16-7.75), work overinvestment (OR 4.78, 95% CI 2.23-10.23), history of mental health problems (OR 3.78, 95% CI 1.82-7.85) and anxiety during pregnancy (OR 7.94, 95% CI 4.29-14.69).

In additional analyses we tested whether the ORs of predictors associated with several trajectories significantly differed. This was the case for work overinvestment (OR for persistent high-level symptoms significantly higher than that for persistent intermediate-level symptoms, p=0.03), and for anxiety (ORs for symptoms in pregnancy only significantly higher than for symptoms in preschool only (*p*=. 005) and persistent intermediate-level symptoms (*p*<. 0001)*, but not for persistent high-level symptoms (*p*=. 304)).

Discussion

<u>Main findings</u>

Using data from a large community based birth cohort study, we identified five distinct trajectory groups of maternal symptoms of depression from pregnancy through the child's 5th birthday (no symptoms: 60.2%, high symptoms in pregnancy: 4.7%, high symptoms in the child's preschool period: 4.9%, persistent intermediate-level symptoms: 25.2% and persistent high-level symptoms: 5.0%).

Depression trajectories – in particular persistent symptoms – appeared especially strongly associated with women's psychosocial and psychiatric characteristics. Particularly, women who are anxious or who experience stressful work conditions during pregnancy may have an increased probability of persistent depressive symptoms over time. Women who present these characteristics may require specific monitoring during pregnancy and afterwards.

Strengths and limitations

The current study has several strengths such as a) a large community sample, b) longitudinal and repeated assessments of multiple demographic, psychosocial and psychiatric characteristics, c) the use of validated measures of maternal mental health. However, we also acknowledge limitations. First, maternal depressive symptoms were self-reported, using two different measures. However, both the CES-D and the EPDS, which we standardized to ensure comparability, have previously been validated and we were able to study the entire depression spectrum rather than diagnoses, which may be a closer estimate of variations in symptomatology at the population level and show higher reliability and validity (Markon *et al.* 2011). Second, we only included baseline predictors, possibly underestimating the influence of factors that can change over time (for example financial difficulties increased from 12.7% at baseline to 22.2% at 5-year follow-up, 92.7% of women were married/ cohabitating compared to 88.5% after 5 years). Nevertheless, this approach allowed us to identify early risk factors that may set women on depressive symptom trajectories from pregnancy onwards. In addition, including baseline predictors might have led to inflation of the associations found between the high symptoms in pregnancy trajectory and possible risk factors due to shared method variance. However, most of the associated socio-demographic, psychosocial and psychiatric risk factors preceded the occurrence of depressive symptoms during pregnancy and are thus unlikely to be biased in this way. Finally, the present study sample is not nationally representative. Compared with a national perinatal survey performed in 2003 on a representative sample of French women (Blondel *et al.* 2006) the EDEN study was similar in age and proportion of unmarried couples but

11

included a larger proportion of women with university level education (53 vs. 43%) (Drouillet *et al.* 2008). This is further increased by selective attrition among socially disadvantaged women. As it is likely that this group has a higher proportion of maternal depression (Ertel *et al.* 2011), our results are plausibly an under- rather than an over-estimate of the relationship between socio-economic predictors and maternal depression trajectories. Replication of our findings in a population including a higher proportion of disadvantaged, high-risk families is warranted.

Maternal depressive symptom trajectories

Exploring maternal depressive symptoms and associated predictors during the early childhood period is important to improve our understanding of the variation in symptom severity and persistence and can clarify why the trajectories of some individuals differ from those of others. Using a trajectory modeling approach we were able to gain insight into five distinct patterns of depressive symptoms from pregnancy onwards. The majority (60.2%) of mothers reported no or very few depressive symptoms across follow-up. This finding is consistent with previous studies, suggesting that most mothers do not experience elevated levels of depressive symptoms during and after the perinatal period (Mora *et al.* 2009; Sutter-Dallay *et al.* 2012).

We identified two groups of women with a marked increase in symptom scores in specific periods. As previously described, a small group of mothers (4.7%) appear to experience depressive symptoms only during pregnancy (Mora *et al.* 2009; Vänskä *et al.* 2011). This may partly be due to measurement issues, as it is sometimes difficult to distinguish depressive symptoms from normal somatic symptoms experienced in pregnancy (e.g. changes in appetite and weight, sleep and energy). It has been suggested that, particularly during pregnancy, depression is best assessed by looking at cognitive-affective symptoms (Pereira *et al.* 2014). The CES-D, used to ascertain depressive symptoms in pregnancy in the EDEN study, mostly covers cognitive symptoms, therefore our measure is probably only moderately affected by such bias. It may be that a unique subgroup of women predominantly suffers from prenatal depression, which resolves post-natally.

12

A third group of women (4.9%) appear to have high symptoms in the child's preschool period only. Although the prevailing view is that women are especially vulnerable to depression in the perinatal period, maternal depression may actually be more common 4 to 5 years after a birth than at any time in the first 12 months postpartum (Najman *et al.* 2000; Woolhouse *et al.* 2014). This may be because child-rearing makes greater demands on the mother's mental health than the perinatal period itself (Betts *et al.* 2014). Contrary to some prior studies, we did not identify a group of women with symptoms exclusively in the postpartum period. It may be that a significant portion of women with postpartum-onset depression remain depressed beyond the child's first year, which would have lead them to them being assigned to one of the groups with persistent symptoms.

Indeed, in both groups of chronic depressive symptoms we noted a steady increase in symptom severity between 4 and 12 months postpartum. Thus, we identified a substantial group of mothers (25.2%) with intermediate-level depressive symptoms throughout follow-up. Finally, consistent with prior research, a small group (5.0%) of women had persistently high depressive symptoms, which were probably above a clinically significant threshold (Campbell *et al.* 2007; Cents *et al.* 2013; Mora *et al.* 2009; Vänskä *et al.* 2011). Although we could not determine how many of these women had diagnosable major depression, their CES-D and EPDS scores were well above established cut-off scores, indicating that their symptoms fall within a clinical range. Our results indicate that these chronic depression trajectories may already start in pregnancy and persist over time.

Predictors of maternal depressive symptom trajectories

Maternal depressive symptoms often occur within a context of personal and environmental risk, and the socio demographic, psychosocial and psychiatric predictors we studied were shared across various trajectories. The only predictor associated with an increased likelihood of depressive symptoms at any moment during follow-up was anxiety during pregnancy, with especially high associations with depression in pregnancy (OR=11.97) and persistently high symptoms (OR=7.94).

Anxiety symptoms are frequently reported by pregnant women and often considered by midwives and obstetricians as part of the normal psychic experiences of pregnancy (Dunkel Schetter & Tanner, 2012; Goodman & Tyer-Viola, 2010). As depression and anxiety during pregnancy are moderately to highly comorbid (Heron *et al.* 2004; Wynter *et al.* 2013), it may be difficult to clearly attribute symptoms to one or the other condition (Skouteris *et al.* 2009). Yet, there is increasing evidence to suggest that antenatal anxiety symptoms form a clinical entity of their own, possible forming a cycle of co-morbidity, whereby initial levels of depressive symptoms lead to higher levels of anxiety, which in turn may then predict higher depressive symptoms (Skouteris *et al.* 2009; Sutter-Dallay *et al.* 2004). Recent studies have suggested that high levels of maternal anxiety during pregnancy could, independently from prenatal depression, predict an elevated risk of long-term depressive symptoms (Horwitz *et al.* 2007; Vänskä *et al*. 2011; Sutter-Dallay *et al.* 2012). However, to our knowledge prior studies had a shorter follow-up than our investigation. We are not aware of studies indicating that the impact of prenatal anxiety lasts even up to five years after birth.

Other variables were more uniquely associated with particular trajectory classes, with women with depressive symptoms in pregnancy only or persistently high depressive symptoms presenting the largest number of risk factors. This suggests that the cumulative effect of multiple risk factors may well increase the chronicity of maternal depressive symptoms, especially since overall there were very few predictor variables that were significantly more strongly related to one trajectory than any other. A specific predictor for depression in pregnancy was a lack of social support. Psychosocial and emotional resources are needed to adapt to the significant life changes associated with pregnancy and the early parenting period (Manuel *et al.* 2012). Insufficient support is negatively associated with maternal psychological well-being during pregnancy and increases the risk of depression, as well as worse health and pregnancy outcomes (Robertson *et al.* 2004; Orr, 2004; Elsenbruch *et al.* 2007). Women reporting any substance use (tobacco, alcohol or cannabis) before pregnancy also had an elevated likelihood (OR= 2.27) for depressive symptoms during pregnancy. Many expectant mothers follow recommendations to maintain a healthy lifestyle during pregnancy,

and they may have stopped or reduced their consummation (Viau *et al.*, 2002). However, reducing or

eliminating substance use by pregnant women has only inconsistently been found to be related to

prenatal depressive symptoms (Solomon *et al.* 2006; Zhu & Valbo, 2002). It is likely that women who

continued their substance use in pregnancy have an increased vulnerability to mental health

problems (Farrell *et al.* 2003; Le Strat *et al.* 2011).

Concerning the predictors of persistently elevated depressive symptoms in mothers from

pregnancy onwards, previous studies have reported that maternal depression is associated with

maternal age, income, relationship and employment status and educational attainment (e.g. Seimyr

et al. 2013; Seto *et al.* 2005; Sutter-Dallay *et al.* 2011). Contrary to these reports, we found that socio

demographic characteristics were not associated with depressive symptoms, with the exception of

non-French origin. Migrant women had a high level of symptoms in pregnancy (OR=4.94) or

persistently high symptoms (OR = 5.92). Pregnant migrant women may go unidentified and untreated

due to underutilization of health services, and therefore, are at increased risk of persistent mental

health difficulties (Giallo *et al.* 2014; Lindert *et al.* 2008). However, as previously indicated, the role

of socio-economic predictors might be underestimated due to the relatively small proportion of

socially disadvantaged women in our sample.

Psychosocial risk factors for persistent depression were the experience of childhood adversity. Our

finding extends prior research that mostly focused on child abuse (Clark *et al.* 2010) (Leigh &

Milgrom, 2008). Additionally, we found an increased likelihood of depression in women who

encountered life stressors during pregnancy. While pregnancy and birth are often regarded as

stressful in their own right, many women have additional stressful experiences during pregnancy

(Robertson *et al.* 2004; Giallo *et al.* 2014), which are consistently shown to be associated with

women's increased vulnerability to post-partum depression (Rubertsson *et al.* 2005). Our results

indicate that stressors in pregnancy are also associated with chronic maternal depression.

Importantly, it appears that depression is not only associated with a high but also a moderate

number of stressors (Liu & Tronick, 2013). Finally, we found that work stress, and particularly work

overinvestment, is associated with persistent depression, of both intermediate and high intensity. Prospective epidemiological studies show that overinvestment, that is an individual's need for approval and esteem at work, is associated with significantly elevated risks of depression (Clark *et al.* 2012; Siegrist, 2008). Pregnancy represents a dynamic period when both work conditions and worker assessment of occupational psychosocial stressors may change. Previous studies found that unskilled and low-waged occupations are often related to adverse employment conditions in pregnancy, including a lack of access to paid and unpaid parental leave. Women experiencing these working conditions are likely to experience greater work-related psychological distress than those who are more advantaged (Cooklin *et al.* 2007; Miyake *et al.* 2011). Yet, paid maternity leave is generally available in France (Ruhm & Teague, 1998) and chi-square comparisons (data not shown) revealed that work overinvestment was not associated with women's socio-demographic characteristics, the type (manual or white collar) or duration (full or part-time) of work they exercised, nor their partner's employment status. It was however more common in women who reported financial difficulties. In addition to work stress, overinvestment may also capture an individuals' personality, characterized by low self-esteem and elements of Type A behavior (Clark *et al.* 2012; van Vegchel *et al.* 2005). It could well be that work overinvestment partly taps into these psychological constructs that have been found to be related to depression etiology. Our finding suggests that work-related stressors should more frequently be studied in the context of pre and postnatal depression, as work–life imbalance may contribute to mental health difficulties in certain women. In our sample, previous mental health problems and use of mental health services were independent psychiatric predictors of chronic depressive symptom trajectories, confirming earlier results (Seimyr *et al.* 2013; Giallo *et al.* 2014).

Conclusion

In the present study we found evidence that depressive symptom trajectories in mothers of young children are heterogeneous and vary with a number of preexisting characteristics. While most mothers do not have depressive symptoms, for some women maternal depression reaches its peak

during pregnancy, in some during the preschool years while others follow a chronic course of symptoms, either of intermediate or high intensity. Women's trajectories of depressive symptoms may be changed when prevention or evidence-based treatment are implemented early on, during pregnancy or in the immediate postpartum. A recent review reported that psychosocial and psychological interventions, compared to usual postpartum care, were associated with a reduction in depressive symptomatology within the first 12 months postpartum (Dennis & Dowswell, 2013). Promising interventions include the provision of intensive, professionally based postpartum home visits, telephone-based peer support, and interpersonal psychotherapy. All of the potential risk factors of long-term depressive symptoms can be identified during routine prenatal care and could contribute to early diagnosis. We recommend that clinicians be specifically attentive to the well-being of women who experience prenatal anxiety symptoms or work related stress. Nevertheless, proactive screening of psychosocial risks still remains a small part of prenatal care and less than 15% of pregnant and postpartum women receive adequate help (Austin *et al.* 2013; Coleman *et al.* 2008). Several psychosocial risk assessment tools, such as the Pregnancy Risk Questionnaire (Austin *et al*. 2005) or the Antenatal Psychosocial Health Assessment (Carroll *et al.* 2005), have been developed to assess pregnant women for the presence of psychosocial risk factors known to be associated with the onset of perinatal depression and anxiety. While some concerns remain about their psychometric properties (Johnson *et al.* 2012), it has been demonstrated that antenatal care providers (midwives, obstetricians, GPs) were more likely to detect concerns and identify a number of risk factors than providers who gave standard care (Austin *et al.* 2008). Identifying women at risk for persistent depressive symptoms, through screening for multiple psychosocial risk indicators during pregnancy, may facilitate interventions targeting risks for maternal mental health problems and associated problematic early child development.

Conflict of interest

None

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Figure 1 Trajectories of maternal symptoms of depression by child's age in months in the EDEN cohort study (n=1807, 2003-2011, France)

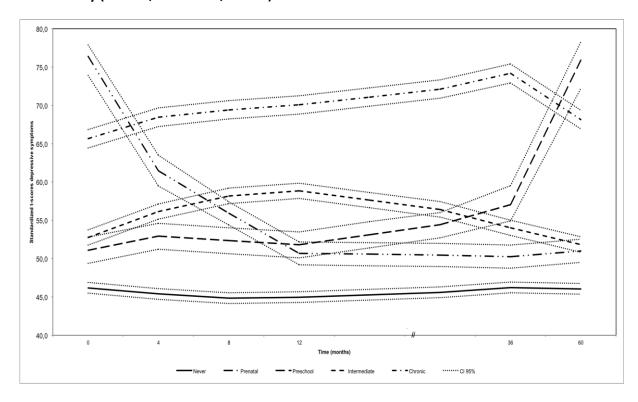| Time (months)	0	4	8	12	36	60
	CES-D	*EPDS*	*EPDS*	*EPDS*	*CES-D*	*CES-D*
No symptoms	8.59 (5.55)	3.02 (2.97)	2.53 (2.57)	2.23 (2.44)	6.44 (4.79)	5.99 (4.50)
High symptoms in pregnancy only	31.88 (8.74)	11.35 (6.27)	8.72 (5.78)	6.81 (4.36)	7.93 (5.54)	10.97 (6.01)
High symptoms in preschool period only	11.94 (5.79)	6.05 (3.81)	5.34 (3.09)	5.29 (3.86)	18.34 (9.84)	26.48 (9.45)
Intermediate-level symptoms level	13.92 (6.00)	8.38 (4.13)	8.61 (4.03)	8.31 (4.08)	13.53 (7.22)	11.39 (5.65)
Persistent high depressive symptoms	24.12 (8.58)	14.61 (5.71)	14.61 (5.16)	15.00 (5.39)	29.73 (9.14)	24.22 (9.72)

Table 1 Unstandardized depressive symptoms by trajectories of maternal depressive symptoms in the EDEN cohort study (n=1807, 2003-2011, France, mean (SD))

CES-D : Center for Epidemiological Studies Depression scale. Clinical cut-off score ≥16

EPDS : Edinburgh Postnatal Depression Scale. Clinical cut-off score ≥12

Table 2 Sociodemographic, psychosocial and psychiatric characteristics of EDEN cohort study participants, n= 1807, 2003-2011, France (N (%) or mean (sd) for continuous variables

	Overall sample (n=1807)	No symptoms (n=1087)	Pregnancy only (n=85)	Preschool only (n=89)	Intermediate (n=456)	Persistent high (n=90)	
	N (%) Mean (sd)	N (%) Mean (sd)	N (%) Mean (sd)	N (%) Mean (sd)	N (%) Mean (sd)	N (%) Mean (sd)	P value
Sociodemographic							
Age at birth (years)							.480
< 30	906 (50.4%)	540 (49.8%)	43 (52.4%)	38 (42.7%)	239 (52.8%)	46 (51.7%)	
≥ 30	892(49.6%)	545 (50.2%)	39 (47.6%)	51 (57.3%)	214 (47.2%)	43 (48.3%)	
Country of origin							<0.001
France	1729 (95.7%)	1054 (97.0%)	7588.2%	86 (96.6%)	435 (95.4%)	79 (87.8%)	
Other	78 (4.3%)	33 (3.0%)	10(11.8%)	3 (3.4%)	21 (4.6%)	11(12.2%)	
Family situation							
Single	131 (7.3%)	65 (6.0%)	8 (9.6%)	8 (9.0%)	41 (9.1%)	9 (10.0%)	.153
Married/Cohabitating	1662 (92.7%)	1014 (94.0%)	75 (90.4%)	81 (91.0%)	411 (90.9%)	81 (90.0%)	
Number of children	.96 (.84)	.93 (.83)	1.10 (.71)	1.04 (.91)	.95 (.85)	1.20 (.88)	.063
Educational level							<0.001
< 12	813 (45.8%)	429 (40.2%)	48 (59.3%)	49 (55.1%)	230 (51.2%)	57 (63.3%)	
≥ 12	964 (54.2%)	639 (59.8%)	33 (40.7%)	40 (44.9%)	219 (48.8%)	33 (36.7%)	
Employment							.011
No	290 (16.1%)	156 (14.4%)	17 (20.2%)	16 (18.0%)	76 (16.7%)	25 (27.8%)	
Yes	1516 (83.9%)	931 (85.6%)	67 (79.8%)	73 (82.0%)	380 (83.3%)	65 (72.2%)	
Educational level partner							.001
< 12	924 (52.3%)	521 (48.8%)	54 (65.1%)	55 (63.2%)	241 (54.6%)	53 (60.9%)	
≥ 12	842 (47.7%)	547 (51.2%)	29 (34.9%)	32 (36.8%)	200 (45.4%)	34 (39.1%)	
Employment partner							.004
No	138 (7.9%)	68 (6.4%)	11 (13.8%)	7 (8.1%)	38 (8.6%)	14 (16.1%)	
Yes	1617 (92.1%)	993 (93.6%)	69 (86.2%)	79 (91.9%)	403 (91.4%)	73 (83.9%)	
Financial difficulties							<0.001
No	1568 (87.3%)	990 (91.7%)	61 (73.5%)	75 (84.3%)	379 (83.5%)	63 (70.0%)	
Yes	228 (12.7%)	90 (8.3%)	22 (26.5%)	14 (15.7%)	75 (16.5%)	27 (30.0%)	
Psychosocial							
≥1 Life events during pregnancy							<0.001
No	1400 (80.2%)	890 (84.0%)	53 (69.7%)	66 (76.7%)	328 (75.1%)	63 (72.4%)	
Yes	345 (19.8%)	169 (16.0%)	23 (30.3%)	20 (23.3%)	109 (24.9%)	24 (27.6%)	
Work related stress							.067
No	1139 (85.4%)	734 (87.5%)	44 (86.3%)	52 (83.9%)	268 (81.0%)	41 (82.0%)	
Yes	194 (14.6%)	105 (12.5%)	7 (13.7%)	10 (16.1%)	63 (19.0%)	9 (18.0%)	
Work overinvestment							<0.001
No	901 (67.5%)	628 (74.8%)	30 (58.8%)	43 (68.3%)	182 (55.0%)	18 (36.0%)	
Yes	434 (32.5%)	212 (25.2%)	21 (41.2%)	20 (31.7%)	149 (45.0%)	32 (64.0%)	
≥1 Childhood adversity							<0.001
No	1272 (70.7%)	826 (76.3%)	40 (48.2%)	58 (65.2%)	310 (68.1%)	38 (42.2%)	
Yes	527 (29.3%)	256 (23.7%)	43 (51.8%)	31 (34.8%)	145 (31.9%)	52 (57.8%)	
Partner any substance use							.007
No	768 (47.0%)	437 (43.6%)	39 (55.7%)	40 (49.4%)	208 (51.2%)	44 (58.7%)	
Yes	866 (53.0%)	565 (56.4%)	31 (44.3%)	41 (50.6%)	198 (48.8%)	31 (41.3%)	
Social support							<0.001
No	68 (3.8%)	30 (2.8%)	13 (15.9%)	2 (2.3%)	14 (3.1%)	9 (10.1%)	
Yes	1718 (96.2%)	1047 (97.2%)	69 (84.1%)	86 (97.7%)	436 (96.9%)	80 (89.9%)	

Psychiatric							
Childhood behavior problems							<0.001
No	1657 (92.7%)	1025 (95.2%)	71 (85.5%)	79 (90.8%)	407 (90.4%)	75 (83.3%)	
Yes	130 (7.3%)	52 (4.8%)	12 (14.5%)	8 (9.2%)	43 (9.6%)	15 (16.7%)	
Previous mental health problems							<0.001
No	1613 (89.3%)	1021 (93.9%)	57 (67.9%)	74 (83.1%)	401 (87.9%)	60 (66.7%)	
Yes	193 (10.7%)	66 (6.1%)	27 (32.1%)	15 (16.9%)	55 (12.1%)	30 (33.3%)	
Pre-pregnancy mental health treatment							<0.001
No	1622 (90.4%)	1007 (93.3%)	65 (78.3%)	77 (86.5%)	400 (88.1%)	73 (81.1%)	
Yes	173 (9.6%)	72 (6.7%)	18 (21.7%)	12 (13.5%)	54 (11.9%)	17 (18.9%)	
Pre-pregnancy substance use							<0.001
No	1141 (63.1%)	737 (67.8%)	38 (44.7%)	53 (59.6%)	267 (58.6%)	46 (51.1%)	
Yes	666 (36.9%)	350 (32.2%)	47 (55.3%)	36 (40.4%)	189 (41.4%)	44 (48.9%)	
Maternal anxiety (STAI) in pregnancy							<0.001
No	1421 (78.9%)	979 (90.4%)	29 (34.1%)	60 (67.4%)	317 (69.8%)	36 (40.0%)	
Yes	380 (21.1%)	104 (9.6%)	56 (65.9%)	29 (32.6%)	137 (30.2%)	54 (60.0%)	

Table 3 Sociodemographic, psychosocial and psychiatric predictors of maternal depression trajectories: EDEN cohort study, n=1334, 2003-2011, France adjusted OR [95% CI], multivariate polynomial logistic regression analysis

	No symptoms [n=832]			Symptoms in pregnancy only [n=56]			Symptoms in preschool only [n=66]			Intermediate symptoms [n=322]			Persistent high [n=60]		
Determinants	OR	[95 % CI]	P value	OR	[95 % CI]	P value	OR	[95 % CI]	P value	OR	[95 % CI]	P value	OR	[95 % CI]	P value
Sociodemographic															
Country of origin: Other	1.00	[ref.]		**4.94**	**[1.35 - 18.07]**	**.016**	.81	[.35 - 7.67]	.529	1.65	[.72 - 3.79]	.238	**5.92**	**[1.86 - 18.86]**	**.003**
Number of children	1.00	[ref.]		.99	[.69 - 1.42]	.947	1.10	[1.50 - 1.64]	.539	.97	[.82 - 1.15]	.729	1.04	[.74 - 1.47]	.802
Educational level: <12 y	1.00	[ref.]		1.22	[.60 - 2.46]	.588	1.05	[.57 - 1.93]	.882	1.26	[.91 - 1.74]	.170	1.28	[.62 - 2.62]	.502
Employment: no	1.00	[ref.]		.60	[.12 - 2.93]	.529	.59	[.13 - 2.57]	.478	.74	[.32 - 1.67]	.465	.47	[.11 - 1.95]	.299
Partner educational level: <12 y	1.00	[ref.]		1.16	[.59 - 2.30]	.670	**1.99**	**[1.09 - 3.65]**	**.025**	1.14	[.83 - 1.57]	.402	.83	[.41 - 1.65]	.588
Partner employment: no	1.00	[ref.]		1.21	[.41 - 3.56]	.732	1.18	[.41 - 3.40]	.754	1.31	[.75 - 2.31]	.343	1.26	[.44 - 3.61]	.668
Financial difficulties: yes	1.00	[ref.]		1.55	[.62 - 3.86]	.348	1.35	[.55 - 3.28]	.511	1.46	[.89 - 2.40]	.138	1.37	[.56 - 3.31]	.488
Psychosocial															
≥1 life event during pregnancy: yes	1.00	[ref.]		1.73	[.87 - 3.47]	.121	1.29	[.66 - 2.52]	.455	**1.47**	**[1.03 - 2.09]**	**.035**	1.40	[.68 - 2.85]	.360
Work related stress: yes	1.00	[ref.]		.80	[.28 - 2.26]	.668	1.77	[.85 - 3.69]	.125	1.46	[.98 - 2.18]	.064	.87	[.32 - 2.36]	.777
Work Overinvestment: yes	1.00	[ref.]		1.57	[.35 - 7.10]	.557	1.10	[.58 - 2.06]	.774	**2.04**	**[1.49 - 2.78]**	**<0.001**	**4.78**	**[2.23 - 10.23]**	**.008**
≥1 Childhood adversity: yes	1.00	[ref.]		**2.49**	**[1.33 - 4.68]**	**.005**	1.56	[.88 - 2.75]	.125	1.11	[.80 - 1.52]	.532	**4.09**	**[2.16 - 7.75]**	**<0.001**
Partner any substance use: yes	1.00	[ref.]		.79	[.41 - 1.54]	.494	.95	[.54 - 1.68]	.870	1.04	[.77 - 1.40]	.800	1.11	[.58 - 2.14]	.743
Social support: no	1.00	[ref.]		**4.31**	**[1.52 - 12.25]**	**.006**	1.05	[.23 - 4.88]	.951	.80	[.32 - 2.01]	.633	2.13	[.64 - 7.05]	.216
Psychiatric															
Childhood behavior problems: yes	1.00	[ref.]		1.15	[.39 - 3.41]	.799	1.64	[.65 - 4.11]	.291	1.65	[.95 - 2.86]	.077	1.72	[.71 - 4.13]	.229
Previous mental health problems: yes	1.00	[ref.]		**2.31**	**[1.02 - 5.22]**	**.044**	1.79	[.80 - 3.98]	.155	1.15	[.67 - 1.95]	.613	**3.78**	**[1.82 -7.85]**	**<0.001**
Pre-pregnancy mental health treatment: yes	1.00	[ref.]		1.38	[.53 - 3.59]	.506	**2.58**	**[1.18 - 5.65]**	**.018**	**1.78**	**[1.09 - 2.93]**	**.022**	1.60	[.68 - 3.77]	.286
Pre-pregnancy substance use: yes	1.00	[ref.]		**2.27**	**[1.17 - 4.39]**	**.015**	1.18	[.65 - 2.12]	.587	1.19	[.87 - 1.62]	.272	1.02	[.52 - 2.00]	.946
Anxiety in pregnancy: yes	1.00	[ref.]		**11.97**	**[6.42 - 22.31]**	**<0.001**	**3.89**	**[2.17 - 6.99]**	**<0.001**	**3.33**	**[2.35 - 4.71]**	**<0.001**	**7.94**	**[4.29 - 14.69]**	**<0.001**

23

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