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Latent Trajectory Classes of Postpartum Depressive Symptoms: A Regional Population-Based Longitudinal Study

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Introduction

Postpartum depression (PPD) affects 10–15% of women (Gavin et al., 2005; O'Hara & Swain, 1996). Symptoms of PPD usually peak at 4 to 6 weeks and, thereafter, gradually decline from 3 months and towards the end of the first year postpartum (Haga et al., 2012; Vliegen et al., 2014). In most studies, it is assumed that participants come from one single, homogenous population that follow the same trajectories in symptomatology over time (see e.g., Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2009; Seto, Cornelius, Goldschmidt, Morimoto, & Day, 2005; Wang, Wu, Anderson, & Florence, 2011; Woolhouse, Gartland, Mensah, & Brown, 2015). However, more recent studies suggest that there are sub-groups of mothers who follow unique trajectories of depressive symptoms, which are associated with different antecedents and outcomes (Ashman et al., 2008; Campbell et al., 2009, 2007; Cents et

al., 2013; Fredriksen et al., 2016; Giallo et al., 2015, 2014; Gross et al., 2009; Luoma et al., 2015; Matijasevich et al., 2015; Mora et al., 2009; Najman et al., 2017; Postpartum Depression: Action Towards Causes and Treatment (PACT) Consortium, 2015; Sutter-Dallay et al., 2012; van der Waerden et al., 2015a, 2015b).

Studies have consistently identified 2–6 classes of women with distinct trajectories and classes of women with minimal symptoms of depression and/or with stable, persistent symptomatology. Some of these have investigated trajectories from mid-pregnancy and up to 1–3 years postpartum (Cents et al., 2013; Fredriksen et al., 2016; Luoma et al., 2015; Mora et al., 2009; Sutter-Dallay et al., 2012), but only one study appears to have examined trajectories in a clinical setting (Christensen et al., 2011). Examining maternal depressive symptoms limited to critical timepoints in the postpartum period is; first of all, more in line with knowledge about PPD (see e.g., Vliegen et al., 2014), and, second, enables us to capture any unique trajectories and risk factors associated with maternal depression that may, potentially, be more relevant for clinical work.

Demographic risk factors such as young age, low education, and ethnicity, tend to be associated with higher, but also moderate, persistent, and stable trajectories (see e.g., Campbell et al., 2007; Cents et al., 2013; van der Waerden, Galéra, Saurel-Cubizolles, et al., 2015). Contextual and psychosocial antecedents such as family stress, low parenting self-efficacy, and social support (or lack thereof; e.g., Ashman et al., 2008; Giallo et al., 2014; Mora et al., 2009), have also been identified to predict to higher and stable trajectories, as well as reports of mental health problems, substance use, and other psychiatric risk factors (see e.g., Fredriksen et al., 2016; Matijasevich et al., 2015; van der Waerden, Galéra, Saurel-Cubizolles, et al., 2015). This wide variety of risk factors may be due to methodological differences between studies (e.g., measurement of depressive symptoms at different timepoints), but may also suggest that there is not sufficient research in this area yet. Furthermore, these studies have consistently found that children whose mothers were assigned to higher trajectories reported more emotional and behavioral problems, than children of mothers assigned to lower trajectories (Ashman et al., 2008; Campbell et al., 2007; Cents et al., 2013; Giallo et al., 2015; Gross et al., 2009; Matijasevich et al., 2015; van der Waerden et al., 2015a). This demonstrates the importance of early prevention and treatment of PPD and examination of maternal trajectories in clinical settings.

Early interventions for PPD show considerable uncertainty regarding their effects, although some appear more beneficial than others (Morrell et al., 2016). One promising psychosocial approach is the 'Edinburgh–method' which uses the Edinburgh Postnatal Depression Scale (EPDS) for screening for depressive symptoms, in combination with supportive counselling. The Edinburgh–method is based on the work by Cox, Holden, and Henshaw (2014), and has been shown to be effective and acceptable (Brealey et al., 2010; Brugha et al., 2011; Morrell et al., 2009a, 2009b). It has been estimated to reduce the prevalence of depression up to 6 months after birth, from 10 to 6% (Larun et al., 2013). However, none of the studies on trajectory classes have examined patterns of depressive symptoms in community-based clinical settings and associations with counselling, while none of the studies on the Edinburgh–method have examined associations of trajectories with maternal, infant, and partner characteristics. This may have important diagnostic, preventive, therapeutic, and prognostic implications for clinical work.

Aim of this study

The purpose of this study was to (a) assess the trajectory of women's depressive symptoms during the first year postpartum to (b) identify potential unobserved classes of women as defined by their

trajectories, (c) identify antepartum and early postpartum risk factors associated with classes, and (d) examine the association between classes and supportive counselling. To the best of our knowledge, no studies have examined trajectories of maternal depression in communities where the Edinburgh–method is implemented in well-baby clinics, which approximately 100% of the target population visits frequently during the first year postpartum, and the association between trajectories and supportive counselling.

Methods

Study design

The present study is a Norwegian population-based prospective cohort study, approved by the Regional Committees for Medical and Health Research Ethics (project no.: 2011/124). Participants were recruited from nine well-baby clinics in five municipalities (i.e., Hamar, Larvik, Løten, Nøtterøy, and Tønsberg) between May 2011 and May 2012. Well-baby clinics offer routine child health care monitoring (i.e., growth and development) but also comprehensive health promoting and preventive services. As such, well-baby clinics are community-based clinics with interdisciplinary teams (i.e., midwives, public health nurses, medical doctors, physiotherapists, and psychologists), working closely with other public health services (e.g., general physicians, daycare centres, and mental health services).

Every expectant or new mother was invited to participate in the study by a midwife or a public health nurse (PHN) at their first consultation, either during pregnancy or at the first home–visit within two weeks after birth. Exceptions were made for asylum seekers, as it was highly uncertain for how long they would stay in the region, and families with active plans of moving out of the region at the time of recruitment. The study had no specific exclusion criteria since well-baby clinics provide free, universal services to all families with children aged 0 to 5. Thus, all families were provided with oral and written information about the study and all families who consented to participate were included. Due to differences in routine consultations, one of the municipalities, including four of the clinics, did not have a routine consultation at 12 months. This is the main reason for the lower number of participants at this measurement.

Setting and Participants

All well-baby clinics had implemented the Edinburgh–method (Cox et al., 2014), and all midwives and PHNs were trained in (1) postpartum depression, (2) identification of mental health problems in new mothers, (3) administering the EPDS, (4) providing supportive counselling, and (5) participated in monthly group supervision, prior to study onset. Upon completing the EPDS, all mothers had an initial session with the midwife or PHN exploring their answers and discussing her current mental health. This initial session, which followed immediately upon filling in the EPDS, is supposed to rule out any false positives or false negatives and validate women's' report on depressive symptoms (e.g., a woman turns out to be more depressed than reported or a high level of symptoms may have a plausible explanation such as a baptism or wedding). A combination of the midwife's or PHN's clinical judgement and the mother's need for support, rather than an EPDS-score of 10 or above alone, determined further follow-up or need for referral. Mothers with indication of severe depression (i.e., EPDS >12 and clinical confirmation) were referred to their general physician (GP) for further evaluation and treatment, while all women indicating thoughts about self-harm (i.e., ≥1 on item 10

on the EPDS) were routinely asked for a history of self-harm and ideation about harming their child. The midwives and PHN's also had clear referral plans, if necessary, and plans for whom to consult if in doubt (e.g., community psychologist). Furthermore, all women with moderate symptom level were offered counselling by the trained midwife or PHN. On average, women received 4–6 sessions with counselling. Women with little progress were referred to specialist care.

Measures

Depressive symptoms were assessed at routine consultations at 1.5, 4, 6, and 12 months postpartum by midwives or PHNs, using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987; Eberhard-Gran, Eskild, Tambs, Schei, & Opjordsmoen, 2001). The EPDS is a 10-item questionnaire with scores ranging from 0–30, and has validated cut-offs at ≥10 and ≥12 that indicate a 'minor depression' and 'probable major depression', respectively (Matthey et al., 2006). In this study, cut-offs were used to count the number of women with a minor and probable major depression at each time point, while continuous scores were used to model the development and heterogeneity in depressive symptoms. In the present study, the Cronbach's alphas ranged from .80–.82 across measurements.

A variety of risk factors were routinely collected by the midwife or PHN from parents or health records at the clinic, either at the first consultation during pregnancy or first home–visit after birth. More specifically, maternal risk factors included age <20 or >36 years, being single, non-Scandinavian ethnicity, low education (i.e., elementary or high-school), unemployed, unplanned/unwanted pregnancy, medical conditions during pregnancy (i.e., any pre-existing or pregnancy-specific diseases such as pre-eclampsia and gestational diabetes, registered in the mother's health record), hereditary somatic diseases in family, complications after birth (i.e., any somatic or mental health complications that required active treatment or extra bedtime in the maternity ward), lack of social support, EPDS score ≥10 during pregnancy, and previous/current mental disorder. Infant risk factors included birth weight <2500 or >4500 gram, disabilities, prenatal pathology, congenital disease, perinatal infections, and neonatal diagnoses. Paternal risk factors were <20 years, non-Scandinavian ethnicity, low education, unemployment, and previous/current mental disorder. Risk factors were scored as present (1) or absent (0).

Finally, PHNs recorded whether women had received counselling since their last routine consultation, following a 'yes/no' format. This included supportive counselling received at the clinic or other treatment such as a community psychologist, GP and/or private practice.

Statistical methods

Descriptives and frequencies were performed by using SPSS v23 (International Business Machines, 2015), while latent growth curve (LGC) and growth mixture (GMM) modelling was performed with Mplus v7.4 (Muthén & Muthén, 1998-2015), using maximum likelihood estimation with robust errors to correct for skewness. The LGC modelling procedure consisted of (1) specifying a single-class LGC model to determine the time course of depressive symptoms in the postpartum period, (2) building a latent class model (i.e., the GMM model) based on the LCG model, (3) assigning mothers to latent classes based on their posterior probabilities for class membership, and (4) examining the association between assigned individual class membership and external variables (i.e., predictors and distal outcomes) by means of multinomial logistic regression (Vermunt, 2010; Wickrama et al., 2016).

Evaluating LGC model fit was done by inspecting the chi-square statistic, comparative fit index (CFI), Tucker Lewis Index (TLI), standardized root mean square residual (SRMR), and the root-mean square error of approximation (RMSEA) and its corresponding 90% confidence interval (CI). The chi-square statistic should be non-significant, but is sensitive to large samples and may lead to rejection of good fitting models. Thus, it is important to look for consistency among the model fit indices. CFI and TLI values ≥.95 and SRMR and RMSEA values ≤.08 are indicative of good-fitting models. Comparison of models was evaluated by the Aikake information criterion (AIC), Bayesian information criterion (BIC), and sample size-adjusted BIC (SaBIC), on a 'smaller-is-better' basis.

For the GMM models, the number of classes was determined by means of the Lo-Mendell-Rubin (LMR) test, LMR adjusted likelihood ratio test (LMR-LRT), and the bootstrapped likelihood ratio test (BLRT), in addition to the information criteria described above (Nylund et al., 2007). LMR, LMR-LRT, and BLRT are used to compare the relative fit of a model with *k* classes to a model with *k*–1 classes, where significant findings suggest an improvement in the model with *k* classes over the model with *k*–1 classes. We also considered entropy values, which indicate the accuracy of classification, where values >.80 are considered acceptable (Ram and Grimm, 2009).

For the GMM models with covariates, we employed the three-step approach (i.e., R3STEP command) to examine the effects of predictors on class membership without changing the underlying model (Asparouhov and Muthén, 2014). Unstandardized beta coefficients and standard errors were then used to calculate the odds ratios (OR) and their corresponding 95% CIs. Finally, to examine the association between class membership and counselling, the reception of supportive counselling during the first-year postpartum was specified as a distal outcome and investigated using the DCAT command (Lanza et al., 2013). The overall chi-square test with ORs and 95% CIs was reported, which compares the OR of receiving counselling between classes. In addition, we reported the probabilities and the odds of counselling within each class. It is also noted that classes comprising less than 5% of the sample and class probabilities of less than .90 were evaluated carefully.

Results

Participants

Norwegian birth numbers have been stable in recent years and the total birth number in the participating municipalities was 1 468 in 2012 (Statistics Norway, 2013). A sample size of 1 374 women would suggest that most women giving birth in this region, consented to participate in this study. Sample characteristics are presented in Table 1 and show that maternal age was similar to average age at all births for mothers in Norway (i.e., 30.4 years; Statistics Norway, 2012). However, participants level of education was higher than in the general population (Statistics Norway, 2015). Most women were also of Scandinavian ethnicity and were either married or living with a partner.

Table 1. Sample characteristics (*N* = 1 374).

Characteristic	*Mothers*
Age (mean ± SD)	30.1 ± 4.9
Education (*n*, %)[a]	
Elementary	114 (8.3)

High-school	344 (25.0)
1-3 yrs. in college or university	549 (40.0)
≥ 4 yrs. in college or university	228 (16.6)
Ethnicity (*n*, %)[a]	
Scandinavian	1089 (79.3)
Other	162 (11.8)
Marital status (*n*, %)[a]	
Married or cohabitant	1203 (87.6)
Single	58 (4.2)

[a]Numbers and percentages adjusted for missing values.

Table 2 presents number of respondents across measurement points and shows that mean scores were generally low and declined over time. Less than 9% of mothers, who scored below the cut-off for minor depression, received counselling. Between 1.4–3.5% reported a minor depression across timepoints; however, less than 60% of these received any counselling. Furthermore, between 1.8–3.8% reported an EPDS–score of 12 or more, whereas about half or less of these women received counselling.

Table 2. Means and standard deviations for EPDS across measurements.

		EPDS	EPDS < 10	Counselling	EPDS 10–11	Counselling	EPDS ≥ 12	Counselling
Measurements	*n* (%)	*m* ± *SD*	*n* (%)	*n* (%)[a]	*n* (%)	*n* (%)[a]	*n* (%)	*n* (%)[a]
6 weeks	1260 (91.7)	4.1 ± 3.6	1168 (92.7)	20 (1.7)	44 (3.5)	4 (9.1)	48 (3.8)	6 (12.5)
4 months	1130 (82.2)	3.0 ± 3.4	1067 (94.4)	92 (8.6)	31 (2.7)	15 (48.4)	32 (2.8)	17 (53.1)
6 months	1032 (75.1)	2.6 ± 3.1	987 (95.6)	72 (7.3)	20 (1.9)	9 (45.0)	25 (2.4)	7 (28.0)
12 months	499 (36.3)	2.2 ± 2.9	483 (96.8)	15 (3.1)	7 (1.4)	4 (57.1)	9 (1.8)	2 (22.2)

[a] Number and percentage of women who received counselling since last consultation based on their EPDS score.

Depressive Symptoms Over Time

Our first aim was to assess the trajectory of women's depressive symptoms during the first year postpartum. Measurement indices for the LGC model across the four timepoints, suggested that the linear model did not fit the data very well (Supplementary Table 1). Consequently, a quadratic slope factor was added, but because the variance of the quadratic slope factor was negligible (i.e., negative or zero; see 'Quadratic M1' in Supplementary Table 1), we did not allow for variance in the quadratic factor. This turned out as an improvement over the linear model ('Quadratic M2' in Supplementary Table 1). As expected, symptoms decreased initially (B = -0.52, p <.01), followed by a flattening in symptoms at 6 months (B = 0.03, p <.01). Consequently, we retained the second quadratic model for subsequent analyses.

Identification of Trajectory Classes

The second aim was to identify potential unobserved classes of women, defined by their trajectories. Hence, a series of GMMs were fitted to determine the optimal number of classes. An initial, unconditional two-class GMM with the variance of the quadratic slope factor fixed to zero, was estimated. The latent variable covariance matrix in both classes, however, was not positive definite, as it turned out that the variance of the linear slope factor was negligible (i.e., negative or zero; Supplementary Table 2). This suggested no variation in the rate of change over time in both classes. Consequently, the variance of the linear slope factor was fixed to zero, which turned out to be the best fitting model used in further analyses. It is noted that we examined alternative models for variances of the latent factors (Supplementary Table 2). The likelihood ratio tests suggested that the two-class solution with variances of both slope factors fixed to zero, was an improvement over the single-class solution, and both the entropy value, class proportions and posterior probabilities were considered good.

Three-, four-, and five-class solutions were fitted as well, but rejected for the two-class solution (Supplementary Table 3). The overall fit of models improved with an increasing number of classes, but the LMR and adjusted LMR-LRT indicated that adding classes beyond the two-class solution did not contribute to distinguish the models. Furthermore, entropy was stable across classes (0.88–0.91), indicating that adding classes did not improve the separation of groups, while the three-, four-, and five-class solutions yielded one or several groups that were relatively small (<5%) and had posterior class probabilities <.90. Taken together, including our research question, parsimony, theoretical justification, and interpretability, the two-class model was considered the best fitting model.

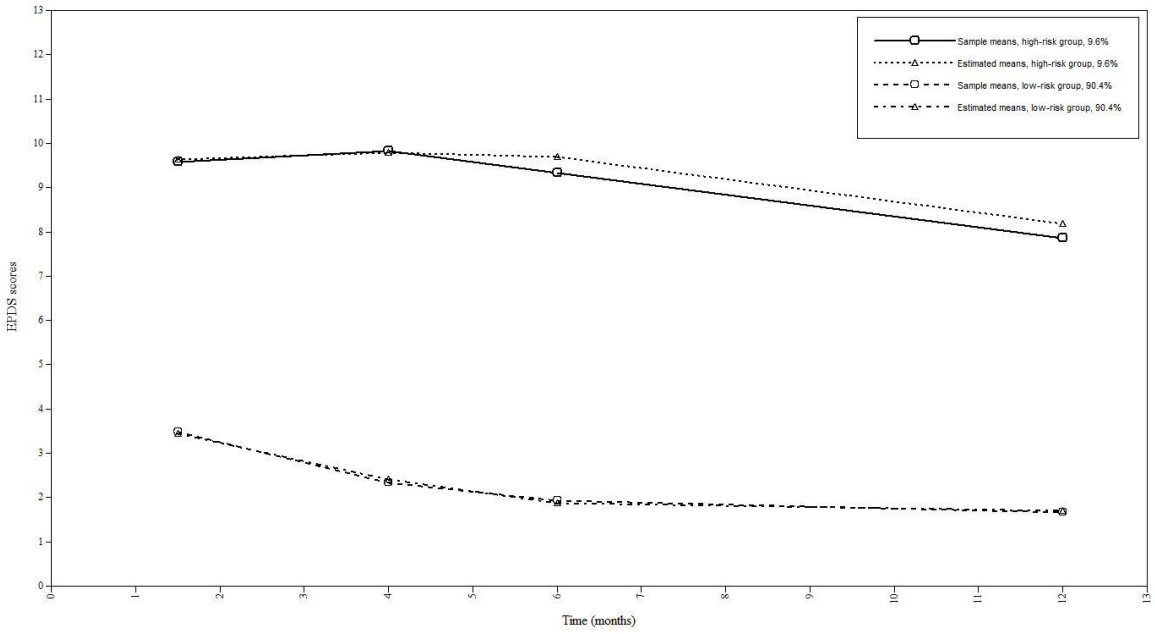

Figure 1. Estimated and observed sample means across the two classes.

Estimated and observed sample means across time for the two classes are depicted in Figure 1. The first group of women scored generally low on depressive symptoms (i.e., 'low-risk'), while the second group had elevated scores just below the cut-off on EPDS (i.e., ≥10; 'high-risk'). Class proportions, means, and variances for the intercept, linear, and quadratic slope factors, are presented in Table 3, for each group. Despite low initial depressive symptoms at 6 weeks postpartum, women in the low-risk group experienced a decline in symptomatology, although the symptom reduction decelerated towards the end of the year. Women in this high-risk group had a higher mean intercept than women in the low-risk group; however, none of the growth factors were significant. This suggests that depressive symptoms remained persistent and moderately high throughout the first year postpartum.

Table 3. Parameters of the two-class growth mixture model (*N* = 1374).

		Intercept		*Linear slope*		*Quadratic slope*	
Group	*Proportion (%)*[a]	*Mean (S.E.)*	*Variance (S.E.)*	*Mean (S.E.)*	*Variance (S.E.)*	*Mean (S.E.)*	*Variance (S.E.)*
Low-risk	0.90	4.25** (0.16)	2.04** (0.35)	-0.58** (0.05)	0.00 (0.00)	0.03** (0.00)	0.00 (0.00)
High-risk	0.10	9.38** (1.03)	2.04** (0.35)	0.20 (0.36)	0.00 (0.00)	-0.03 (0.03)	0.00 (0.00)

Note. Variances were held equal across classes. S.E. = standard error. * $p < .05$. ** $p < .01$.

[a] Final class counts and proportions for the latent classes based on their most likely latent class membership.

Risk Factors Associated with Trajectory Classes

The third aim was to identify antepartum and early postpartum risk factors associated with trajectory classes. Maternal, infant, and paternal risk factors were investigated; first, separately and, then, simultaneously, using the low-risk class as a reference. Univariate analyses found several maternal risk factors associated the high-risk class (Table 4); including non-Scandinavian ethnicity, unemployment, unplanned/unwanted pregnancy, complications after birth, lack of social support, elevated depressive symptoms during pregnancy, and previous psychopathology. Non-Scandinavian ethnicity and unemployment among fathers were also predictive of membership in the high-risk class, while the only infant characteristic associated with class membership was gestational week. However, in the multivariate model, only complications after birth, elevated depressive symptoms during pregnancy, and previous psychopathology remained significant, in addition to infant gestational week.

Table 4. Results from multinomial logistic regression analyses on group predictors.[a]

			Univariate models				*Multivariate model*			
Risk factors[b]	*N*	*n (%)*[c]	*Est.*	*S.E.*	*OR*	*95% CI*	*Est.*	*S.E.*	*OR*	*95% CI*
Maternal										
Age (i.e., < 20 or > 36 years)	1260	131 (9.5)	0,41	0,33	1,51	[0.79, 2.87]				
Ethnicity (i.e., non-Scandinavian)	1260	159 (11.6)	0.86**	0,28	2,36	[1.37, 4.06]	0,43	0,55	1,54	[0.53, 4.52]
Education (i.e., elementary or high-school)	1260	370 (26.9)	0,28	0,24	1,32	[0.83, 2.12]				
Single mother	1260	58 (4.2)	0,45	0,46	1,57	[0.64, 3.89]				
Unemployed	1260	152 (11.1)	1.06**	0,27	2,89	[1.70, 4.91]	0,28	0,39	1,32	[0.62, 2.81]
Unplanned or unwanted pregnancy	1260	214 (15.6)	0.67*	0,26	1,96	[1.17, 3.27]	0,30	0,34	1,35	[0.69, 2.62]
Medical conditions during pregnancy	1260	255 (18.6)	0.85**	0,24	2,34	[1.45, 3.77]	0,40	0,29	1,49	[0.85, 2.62]
Hereditary somatic diseases in family	1260	215 (15.6)	-0,12	0,32	0,89	[0.48, 1.65]				
Complications after birth	1260	132 (9.6)	1.06**	0,28	2,89	[1.66, 5.05]	0.69*	0,32	1,99	[1.06, 3.74]
Lack of social support	1260	35 (2.5)	1.34**	0,46	3,80	[1.54, 9.36]	0,33	0,52	1,39	[0.50, 3.87]
High EPDS score during pregnancy	1260	117 (8.5)	2.05**	0,27	7,77	[4.58, 13.16]	1.41**	0,32	4,09	[2.18, 7.69]
Previous or current mental disorder	1260	176 (12.8)	1.71**	0,25	5,54	[3.41, 9.01]	1.11**	0,32	3,03	[1.63, 5.64]
Infant										
Birth weight (i.e., < 2500 or > 4500 gram)	1260	80 (5.8)	-1,17	0,80	0,31	[0.06, 1.49]				
Gestational week (i.e., < 37 or > 41 weeks)	1260	264 (19.2)	-0.95*	0,39	0,39	[0.18, 0.83]	-0.90*	0,43	0,41	[0.18, 0.94]
Prenatal pathology	1260	29 (2.1)	0,24	0,69	1,27	[0.33, 4.93]				

Congenital disease	1260	24 (1.7)	0,48	0,69	1,62	[0.42, 6.30]				
Perinatal infection	1260	40 (2.9)	-0,17	0,70	0,84	[0.21, 3.35]				
Neonatal diagnosis	1260	80 (5.8)	-0,42	0,56	0,66	[0.22, 1.98]				
Paternal										
Age (i.e., < 20 years)	1260	24 (1.7)	-0,04	0,85	0,96	[0.18, 5.11]				
Ethnicity (i.e., non-Scandinavian)	1260	161 (11.7)	1.04**	0,27	2,83	[1.67, 4.77]	0,76	0,51	2,13	[0.78, 5.82]
Education (i.e., elementary or high-school)	1260	428 (31.1)	0,17	0,24	1,18	[0.74, 1.88]				
Unemployed	1260	66 (4.8)	1.16**	0,36	3,19	[1.57, 6.48]	0,02	0,46	1,02	[0.41, 2.53]
Previous or current mental disorder	1260	65 (4.7)	0,48	0,44	1,62	[0.69, 3.80]				

Note. Est. = unstandardized beta coefficient. S.E. = standard error. OR = odds ratio. 95% CI = 95% confidence interval for OR. * $p < .05$. ** $p < .01$.

[a] Listwise deletion applied to the auxiliary covariates in the analysis. For sample size used for analysis, see column N.

[b] Dichotomous variables.

[c] Percentages based on the overall sample size (N = 1374).

Trajectory Classes and Counselling

The final aim was to examine the association between trajectory classes and supportive counselling. The overall test of the GMM model with supportive counselling as a distal outcome was significant ($\chi^2(1) = 98.48$, $p < .01$). Table 5 presents the number of women that received supportive counselling within classes, and their corresponding probabilities and standard errors. The odds of receiving supportive counselling was 0.09 and 1.85 in the low- and high-risk classes, respectively. In other words, most women did not receive supportive counselling and chances were small that women in the low-risk class received counselling. Most important, the OR for receiving supportive counselling was 19.78 (95% CI = 11.03–35.48) for women in the high-risk compared against the low-risk class.

Table 5. Equality tests of probabilities across classes (*N* = 1368).

Group	*N (%)*	*Probability*	*S.E. Prob.*
Low-risk			
No counselling	1109 (81.1)	0.91	0.01
Counselling	140 (10.2)	0.09	0.01
High-risk			
No counselling	50 (3.7)	0.35	0.06
Counselling	69 (5.0)	0.65	0.06

Note. S.E. Prob. = standard error of probability.

Discussion

The purpose was to (a) assess the trajectory of depressive symptoms during the first year postpartum to (b) identify unobserved trajectory classes of women, (c) identify antepartum and early postpartum risk factors associated with identified classes, and (d) examine the association between classes and counselling. Women followed a traditional pattern in depressive symptomatology, with an initial decrease early postpartum followed by a deceleration in symptoms. However, our results identified two distinct trajectory classes of women. One class, which accounted for 90% of the sample, had a low symptom level that declined with time ('low-risk'). The second group, classified as 'high-risk', had persistent depressive scores across time, slightly below the cut-off for a minor depression. Women assigned to the high-risk group were characterized by having experienced complications after birth, a high EPDS-score during pregnancy, and previous mental illness. Being classified in the high-risk group, however, was associated with receiving counselling.

The two classes are similar to those reported by Giallo and colleagues (2014), except that the group with persistently high symptoms was larger in their study (i.e., 16%). We did not identify any group with chronic, severe symptoms as in previous studies (Campbell et al., 2009; Gross et al., 2009; Matijasevich et al., 2015); however, these findings are consistent with a similar Norwegian study (Fredriksen et al., 2016). It may be that pregnant women in Norway receive such generous healthcare services that there is not a sufficiently clear/large group of women with severe symptoms,

although Sutter-Dallay and colleagues (2012) found such a severely-high group even in a low-risk sample in France. These results could also reflect an effect of the Edinburgh-method. After all, high-risk women had 20 times increased likelihood of receiving counselling compared to low-risk women.

Despite that false-positives has been used as an argument against screening (Larun et al., 2013; The National Council for Priority Setting in Health Care, 2013), this study shows that few low-risk women received counselling. A greater concern is why 35% women in the high-risk group did not receive any intervention, although there may be plausible explanations for this. For example, some women may have already been receiving social support from friends/family and, because previous mental illness was a risk factor for being classified in the high-risk group, some of these women may have declined counselling because they were already receiving professional mental health treatment. The 35% who did not receive counselling, may also explain the stable and moderately persistent symptoms observed in this trajectory class or why symptoms did not decline. Thus, it will be important for future research to determine the effectiveness of the Edinburgh-method in this high-risk group and compare those who received counseling to those who did not.

Only complications after birth, a high EPDS-score during pregnancy, previous psychopathology, and infant gestational week, remained significant after examining risk factors simultaneously. The findings correspond to previous research which shows that a high antenatal EPDS-score and previous mental illness predicts higher, stable, and intermittent trajectories (Cents et al., 2013; Fredriksen et al., 2016; Luoma et al., 2015; Najman et al., 2017; van der Waerden et al., 2015b). Complications after birth, however, have previously only been associated with the most severe symptoms in clinical samples (PACT, 2015), whereby this study shows that complications related to childbirth may contribute to develop and sustain postpartum depressive symptoms, even in non-clinical samples.

Most surprising was that sub-optimal gestational week varied by trajectory and suggested a lowered association with the high-risk group (i.e., a protective factor). It is not known whether this is due to premature or late births, which should be examined further in future research. However, given that the results indicate this was a protective factor, it is hypothesized that this finding can be due to women with late-born infants (i.e., >41 weeks gestation). An explanation for this may be that women with PPD usually perceive their world as more threatening and unsafe (e.g., 'the vulnerable baby'), coupled with a loss of a fundamental sense of identity (e.g., feelings of depersonalization; Røseth, Binder, & Malt, 2011). Late–births may thus be protective by changing women's perceptions of their pregnancy and baby, as healthier, and less vulnerable and overwhelming, without compromising their sense of security and control.

Implications

The implications of this study indicate that health personnel should consider offering counselling at an elevated initial mean symptom score on depression for early prevention, even though it may not formally be above a cut-off at a discrete timepoint. This is important as depressive symptoms among women in the high-risk group did not seem to decrease over time and may become burdensome for the mother and her family. However, mean variances also suggest that screening for PPD should include an assessment of the risk factors related to the high-risk trajectory class in this study, to more easily identify women in risk of moderate, stable symptomatology, for continued follow-up. Sub-clinical symptoms are subject to the tricky 'gray-area' worries that may preclude the assessment of whether to offer counselling among health personnel and elicit reluctance among women in accepting counselling. As such, the results in this study can support health personnel to more easily manage women 'of concern' by helping them to clearly convey expected future development in depressive symptoms for women in high risk. For women, who still reject counselling, it thus

becomes a professional, ethical duty to, at least, offer continued monitoring. In the case of repeated sub-clinical scores, health personnel should thus consider exploring whether she has overriding difficulties that put her at risk over time and keep struggling with persistent symptoms. In contrast the high-risk group, it may be that women in the low-risk group may not need to be monitored as frequently as their mean symptom levels are rather low and even decrease over time, thereby making the Edinburgh-method potentially even more cost-efficient.

Limitations

This study has some limitations; First, women in this study had a higher educational level than the general population and EPDS-scores were generally low, which may have prevented finding classes with severe symptoms. Thus, this compromises the generalizability of the results. Second, one of the municipalities, with four of the nine well-baby clinics, did not have a 12–months routine consultation, which is the primary reason for the lower number of participants at this measurement. Third, the study was conducted in a community-based clinical setting with the Edinburgh-method implemented as part of routine practice. Although more than 200 Norwegian well-baby clinics use the Edinburgh-method, these results may not apply to other well-baby clinics. Fourth, depressive symptoms were assessed using the EPDS, which is a self-report measure, whereas a clinical or diagnostic interview of depression may have yielded somewhat differentiated results. A similar concern is that, although risk factors were extracted from medical records, these were often assessed by means of single-items, some of which were based on self-reports. This may not fully have captured the complexity of some of the risk factors. Fifth, this study did not include any child or partner outcomes.

Conclusion

This study found two trajectory classes; distinguished by various risk factors and the reception of counselling. Researchers and clinicians need to be aware of the heterogeneity among postpartum women, risk factors associated with these high-risk women, and include assessments of trajectories for the early prevention of PPD. Future research needs to determine whether more high-risk women should receive counselling and whether the Edinburgh-method is effective among these women.

Indication of Tables

Table 1. Sample characteristics.

Table 2. Means and standard deviations for EPDS across measurements.

Table 3. Parameters of the two-class growth mixture model.

Table 4. Results from multinomial logistic regression analyses on class predictors.[a]

Table 5. Equality tests of probabilities across classes (N = 1368).

Indication of Supplementary Tables

Supplementary table 1. Summary of fit indices for latent growth curve models.

Supplementary table 2. Summary of fit indices for unconditional two-class growth mixture models.

Supplementary table 3. Summary of fit indices for different number of classes.

Indication of Figures

Figure 1. Estimated and observed sample means across the two classes.

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Supplementary Tables

Supplementary table 1. Summary of fit indices for latent growth curve models.

Model	*AIC*	*BIC*	*SaBIC*	χ^2 *(df)*	*CFI*	*TLI*	*SRMR*	*RMSEA*	*90% CI*
Linear	19685.56	19732.59	19704.00	98.71* (5)	0.91	0.89	0.07	0.12*	0.01, 0.14
Quadratic M1	19596.70	19664.64	19623.34	1.85 (1)	1.00	1.00	0.01	0.03	0.00, 0.08
Quadratic M2	**19616.77**	**19669.02**	**19637.26**	**27.91* (4)**	**0.98**	**0.97**	**0.05**	**0.07**	**0.04, 0.09**

Note. Text in bold indicates model used for subsequent analyses. AIC = Aikake's information criterion. BIC = Bayesian information criterion. SaBIC = Sample-size adjusted BIC. χ^2 (df) = Chi-square with degrees of freedom. CFI = Comparative fit index. TLI = Tucker Lewis Index. SRMR = Standardized Root Mean Square Residual. RMSEA = Root-mean square error of approximation. 90% CI = 90% confidence interval for RMSEA. * *p*-value < .01.

Supplementary Table 2. Summary of fit indices for unconditional latent 2-class growth models.

	Information criteria			*Likelihood ratio tests, p-values*									
Models	*AIC*	*BIC*	*SaBIC*	*LMR*	*LMRT-LMR*	*BLRT*	*Entropy*	*N*[a]	*%*[a]	*n*[b]	*%*[b]	*Class 1 probability*	*Class 2 probability*
Model 1[c,d]	19190.54	19279.37	19225.37	< .01	< .01	< .01	0.88						
Class 1								1234	0.90	1219.30	0.89	0.89	0.11
Class 2								140	0.10	154.70	0.11	0.02	0.98
Model 2[c,d]	19241.35	19314.50	19270.03	< .01	< .01	< .01	0.89						
Class 1								1261	0.92	1244.84	0.91	0.98	0.02
Class 2								113	0.08	129.16	0.09	0.12	0.88
Model 3[d]	**19300.89**	**19363.60**	**19325.48**	**< .01**	**< .01**	**< .01**	**0.90**						
Class 1								**1254**	**0.91**	**1242.24**	**0.90**	**0.98**	**0.02**
Class 2								**120**	**0.09**	**131.76**	**0.10**	**0.10**	**0.90**
Model 4[d]	19511.17	19568.65	19533.70	< .01	< .01	< .01	0.89						
Class 1								1192	0.87	1183.67	0.86	0.98	0.02
Class 2								182	0.13	190.33	0.14	0.10	0.90

Note. Text in bold indicates models used for subsequent analyses. AIC = Aikake's information criterion. BIC = Bayesian information criterion. SaBIC = Sample-size adjusted BIC. LMR = Lo-Mendell-Rubin test. LMR-LRT = Lo-Mendell-Rubin adjusted likelihood ratio test. BLRT = Bootstrapped likelihood ratio test.

[a] Final class counts and proportions for the latent classes based on their most likely latent class membership.

[b] Final class counts and proportions for the latent classes based on the estimated model.

[c] Latent variable covariance matrix not positive definite.

[d] Model 1 = variances of intercept and growth factors estimated freely. Model 2 = variance of quadratic factor fixed at 0. Model 3 = variance of linear and quadratic factors fixed at 0. Model 4 = variances of intercept and growth factors fixed at 0.

Supplementary Table 3. Summary of fit indices for different number of classes.

	Information criteria			*Likelihood ratio tests, p-values*								*Probabilities*				
Model(s)	*AIC*	*BIC*	*SaBIC*	*LMR*	*LMRT-LMR*	*BLRT*	*Entropy*	*N*[a]	*%*[a]	*n*[b]	*%*[b]	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*
1-class	19616.77	19669.02	19637.26													
2-class	**19300.89**	**19363.60**	**19325.48**	**< .01**	**< .01**	**< .01**	**0.90**									
Class 1								**1254**	**0.91**	**1242.24**	**0.90**	**0.98**	**0.02**			
Class 2								**120**	**0.09**	**131.76**	**0.10**	**0.10**	**0.90**			
3-class	19088.00	19171.61	19120.78	0.31	0.32	< .01	0.91									
Class 1								102	0.07	115.13	0.08	0.86	0.03	0.11		
Class 2								43	0.03	51.79	0.04	0.08	0.88	0.04		
Class 3								1229	0.89	1207.08	0.88	0.02	0.01	0.97		
4-class	18922.47	19026.98	18963.44	0.20	0.21	< .01	0.90									
Class 1								133	0.10	141.96	0.10	0.83	0.01	0.13	0.03	
Class 2								16	0.01	17.75	0.01	0.04	0.96	0.00	0.00	
Class 3								1166	0.85	1146.42	0.83	0.02	0.00	0.96	0.01	
Class 4								59	0.04	67.88	0.05	0.06	0.02	0.10	0.82	
5-class	18828.06	18953.47	18877.23	0.16	0.17	< .01	0.88									
Class 1								16	0.01	17.76	0.01	0.96	0.00	0.00	0.00	0.03

Class 2	47	0.03	54.79	0.04	0.02	0.84	0.01	0.09	0.06
Class 3	29	0.02	49.79	0.04	0.00	0.00	0.80	0.05	0.16
Class 4	1157	0.84	1127.20	0.82	0.00	0.01	0.01	0.96	0.02
Class 5	125	0.09	124.47	0.09	0.01	0.03	0.09	0.11	0.76

Note. Text in bold indicates best fitting model. AIC = Aikake's information criterion. BIC = Bayesian information criterion. SaBIC = Sample-size adjusted BIC. LMR = Lo-Mendell-Rubin test. LMRT-LMR = Lo-Mendell-Rubin adjusted likelihood ratio test. BLRT = Bootstrapped likelihood ratio test.

[a] Final class counts and proportions for the latent classes based on their most likely latent class membership.

[b] Final class counts and proportions for the latent classes based on the estimated model.