TILBURG UNIVERSITY

Tilburg University

Social media use as a risk factor for depressive symptoms during pregnancy

Muskens, L.; Hulsbosch, L.P.; van den Heuvel, M.I.; Croes, E.A.J.; Kop, W.J.; Pop, V.J.M.; Boekhorst, M.G.B.M.

Published in:
Journal of Affective Disorders

DOI:
10.1016/j.jad.2023.06.045

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

Link to publication in Tilburg University Research Portal

Citation for published version (APA):
Muskens, L., Hulsbosch, L. P., van den Heuvel, M. I., Croes, E. A. J., Kop, W. J., Pop, V. J. M., & Boekhorst, M. G. B. M. (2023). Social media use as a risk factor for depressive symptoms during pregnancy. *Journal of Affective Disorders*, *338*, 495-501. https://doi.org/10.1016/j.jad.2023.06.045

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 12. Kas. 2024

Journal of Affective Disorders 338 (2023) 495–501

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Social media use as a risk factor for depressive symptoms during pregnancy

Lotte Muskens [a,*], Lianne P. Hulsbosch [a], Marion I. van den Heuvel [b], Emmelyn A.J. Croes [c], Willem J. Kop [a], Victor J.M. Pop [a], Myrthe G.B.M. Boekhorst [a]

[a] Department of Medical and Clinical Psychology, Tilburg University, Tilburg, the Netherlands
[b] Department of Cognitive Neuropsychology, Tilburg University, Tilburg, the Netherlands
[c] Department of Communication and Cognition, Tilburg University, Tilburg, the Netherlands

ARTICLE INFO

Keywords:
Bergen Social Media Addiction Scale
Depressive symptoms
Edinburgh Depression Scale
Growth mixture modeling
Longitudinal
Perinatal
Social media use
Trajectories

ABSTRACT

Background: Accumulating research has shown associations between excessive social media use (SMU) with depressive symptoms. Depression is common during pregnancy, but it is not known whether SMU plays a role in the etiology and clinical course of depressive symptoms during pregnancy.
Methods: The current study is a prospective cohort study with Dutch-speaking pregnant women recruited at the first antenatal appointment (N = 697). Depressive symptoms were measured at each trimester of pregnancy using the Edinburgh Depression Scale. Growth mixture modeling was used to determine classes of women based on longitudinal trajectories of depressive symptoms. SMU was assessed at 12 weeks of pregnancy, specifically, intensity (time and frequency) and problematic SMU (Bergen Social Media Addiction Scale). Multinomial logistic regression analyses were used to examine the associations between SMU and trajectories of depressive symptoms.
Results: Three trajectories of depressive symptoms during pregnancy were identified: a low stable (N = 489, 70.2 %), intermediate stable (N = 183, 26.3 %), and high stable (N = 25, 3.6 %) class. SMU Time and Frequency were significantly associated with belonging to the high stable class. Problematic SMU was significantly associated with belonging to the intermediate or high stable class.
Limitations: The study does not allow to draw conclusions about causality. The group sizes of the three trajectories differed considerably. Data were collected during the COVID-19 pandemic which may have influenced the results. SMU was measured by self-report.
Conclusions: These results indicate that both higher intensity of SMU (time and frequency) and problematic SMU may be a risk factor for higher levels of prenatal depressive symptoms during pregnancy.

1. Introduction

Pregnancy is associated with multiple psychological, social, and physical changes. Depressive symptoms during this period are common, with a prevalence rate up to 15 % (Bennett et al., 2004; Gavin et al., 2005; Okagbue et al., 2019; Woody et al., 2017). Over last decades, a significant increase in depressive symptom levels in pregnant women was demonstrated, while potential protective and predisposing factors (e.g., employment, higher educational level, smoking and alcohol use) improved (Pop et al., 2019). One suggestion for this paradox could be the growing extensive social media use (SMU) by young adults, including pregnant women (Pew Research Center, 2021; Pop et al., 2019).

Accumulating research has shown an association between excessive SMU and depressive symptoms in both adolescent and adult populations (Boer et al., 2021; Boer et al., 2020; Hussain and Griffiths, 2018; Lin et al., 2016; Shensa et al., 2017; Shensa et al., 2018). SMU is described as *intense* when individuals use social media "very often"(Müller et al., 2016), characterized by >7 h a day (Boer et al., 2020; Griffiths et al., 2014; Kelly et al., 2018). Moreover, SMU becomes *problematic* when users are not able to control their use of social media, experience negative emotions (e.g., stress and anxiety) when unable to access social media, and think excessively of SMU (Griffiths et al., 2014). A plausible mechanism involved in the adverse consequences of more intense and problematic SMU may be a decrease in face-to-face social and community engagement resulting in increased social isolation, which could lead to depressive symptoms (Ge et al., 2017; Meshi and Ellithorpe, 2021; Shensa et al., 2017). In line with this, another study found that intense social media users generally spend less offline time with their friends or family (Boer et al., 2020). However, this association can also be the

* Corresponding author at: Department of Medical and Clinical Psychology, Tilburg University, Warandelaan 2, 5037 AB Tilburg, the Netherlands.
E-mail address: l.muskens@tilburguniversity.edu (L. Muskens).

https://doi.org/10.1016/j.jad.2023.06.045
Received 5 October 2022; Received in revised form 22 May 2023; Accepted 20 June 2023
Available online 24 June 2023
0165-0327/© 2023 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

other way around, for example, loneliness, an important predictor of depression, could be an important driver of frequent internet use (O'Day and Heimberg, 2021).

Recently, Smith et al. (2020) reported that digital media use in pregnant women was related to more negative affect, self-criticism, and lower quality of life. However, to our knowledge, the possible role of (intensity of and problematic) SMU in the etiology of prenatal depressive symptoms has not yet been investigated, even though pregnant women may be more vulnerable to social isolation. Due to reduced mobility (especially in the third trimester) and changes in social and work-related activities they may have reduced social contact with others (Yang, 2018). Moreover, young women may also be more likely to use social media for information seeking and reassurance because of pregnancy-specific worries (e.g., health of the fetus, mode of delivery, initiation of breastfeeding) (Lupton and Pedersen, 2016; Smith et al., 2020), especially when it concerns their first pregnancy.

Because depressive symptoms can vary substantially over time, it is especially important to assess depressive symptoms longitudinally (Nandi et al., 2009). A method which takes into account the symptom variability over time both between and within individuals is growth mixture modeling (Santos Jr. et al., 2017). The primary aim of this study was to assess whether prenatal social media use (SMU) was associated with trajectories of depressive symptoms during pregnancy. Based on previous research in non-pregnant populations (Boer et al., 2021; Boer et al., 2020; Hussain and Griffiths, 2018; Lin et al., 2016; Shensa et al., 2017; Shensa et al., 2018) it was hypothesized that women with more intense and problematic SMU would show heightened depressive symptom levels during pregnancy.

2. Methods

2.1. Participants and procedure

Participants were recruited as part of the Brabant Study, a large longitudinal prospective cohort study, in the south of the Netherlands (for protocol see, Meems et al. (2020)). During the first antenatal visit, Dutch-speaking pregnant women (18+ years) were recruited by their midwife or obstetrician. Exclusion criteria were multiple pregnancy, known endocrine disorder before pregnancy (other than thyroid function problems), type I diabetes mellitus, rheumatoid arthritis, severe psychiatric disorders (schizophrenia, borderline personality disorder, or bipolar disorder), HIV, drug or alcohol addiction problems or any other disease resulting in treatment with drugs that are potentially harmful for the fetus and need careful follow-up during pregnancy. Essential hypertension was not an exclusion criterion as long as the women were normotensive at inclusion.

Participating women completed online questionnaires assessing depressive symptoms at 12, 20 and 28 weeks of pregnancy. Up until May 2021, 1199 women filled out the questionnaire around 12 weeks of pregnancy (+/− four weeks). Women who were included in the Brabant Study in January 2020 and onwards also filled out a questionnaire assessing SMU at 12 weeks of pregnancy. Therefore, the 481 pregnant women who were included before this date were not included in the analyses. This resulted in a final study sample of 697 women. No differences emerged between the included and non-included samples of women, except for parity. Women in the included sample were more often primiparous ($\chi^2(1) = 4.67$, $P = .031$, phi coefficient = 0.06, small effect size).

The Brabant Study was approved by the Medical Ethics Committee at the Máxima Medical Centre Veldhoven (NL64091.015.17). All participants provided written informed consent.

2.2. Measures

2.2.1. Depressive symptoms during pregnancy

Depressive symptoms over the past seven days were assessed using the Dutch version of the 10-item Edinburgh Depression Scale (EDS) (Cox et al., 1987; Pop et al., 1992). This questionnaire has been validated among Dutch pregnant women for use during pregnancy (Bergink et al., 2011). The items were scored on a four-point scale ranging from 0 to 3. Total EDS scores range from 0 to 30, with higher scores indicating higher levels of depressive symptoms. During pregnancy a cut-off of 11 for depressive symptoms at the first trimester has been described, and of 10 during the second and third trimesters (Bergink et al., 2011). The EDS is a valid and reliable instrument to assess depressive symptoms (Bergink et al., 2011; O'Connor et al., 2016; Pop et al., 1992). In the current study, the Cronbach's alphas were 0.84, 0.83 and 0.85 per trimester, respectively.

2.2.2. Social media use

We measured both *intensity* of SMU and *problematic* SMU, at 12 weeks of pregnancy. Social media were defined as: "Facebook, Instagram, LinkedIn, Pinterest, Twitter, YouTube, etc.".

2.2.2.1. Intensity of social media use. The intensity was measured by time and frequency of SMU. SMU Time was measured by asking how many hours per day participants used social media. Participants could select one of nine answer options ranging between *1 = I don't use social media* and *9 = seven or more hours a day*. The answers were converted into actual hours a day that ranged between 0 and 7 h. For example, *I don't use social media* was recoded to *0 h, less than half an hour a day* to *0.5, 3 h a day* to *3 h* and *7 or more hours a day* was recoded to *7 h.* When using the original scale, the distances between the categories is not equal. For example, there is a difference of 0.5 between *1 = I don't use social media* and *2 = less than half an hour a day*, while there is a difference of 1 between *3 = 1 h a day* and *4 = 2 h a day*. Therefore, these categories were converted into a continuous scale.

SMU Frequency was measured by asking how frequently participants visited social media platforms. There were seven answer options ranging between *1 = I don't use social media* and *7 = five or more times a day* (Shensa et al., 2017; Shensa et al., 2018), which were converted into mean social media visits per week that ranged between 0 and 35 times (Shensa et al., 2017; Shensa et al., 2018). More specifically, *I don't use social media* was recoded to *0 visits, less than once a week* was recoded to *0.5 visits, 3–6 days a week* to *4.5 visits* and *5 or more times a day* was recoded to *35 visits*.

2.2.2.2. Problematic social media use. Problematic SMU was assessed with the six-item Bergen Social Media Addiction Scale (BSMAS) at 12 weeks of pregnancy (Andreassen et al., 2016). The BSMAS is an adaptation of the validated Bergen Facebook Addiction Scale (Andreassen et al., 2012) to assess problematic use of social media in general (Andreassen et al., 2016). Each item represents one of six core elements of addiction, namely salience, mood modification, tolerance, withdrawal, conflict, and relapse (Griffiths, 2005). An example item is: *"How often during the last year have you felt an urge to use social media more and more?"* Total BSMAS scores range from 6 to 30, with higher scores indicating more problematic SMU. In the current study, the BSMAS showed a Cronbach's alpha of 0.77.

Furthermore, in the current study, a cut-off score of 3 or above on at least four of the six items, indicates a *potential social media addiction* (Andreassen et al., 2012).

2.2.3. Demographics and pregnancy-related characteristics

At 12 weeks of pregnancy, demographic and pregnancy-related characteristics were collected including *age* (years), *level of education* (low/high (high: Bachelor's degree or higher)), *employment* (yes/no), *having a partner* (yes/no), *parity* (primiparous/multiparous), *unplanned pregnancy* (yes/no), *previous miscarriage or abortion* (yes/no), *obstetric complication* (including intrauterine growth restriction, pre-eclampsia, and diabetes gravidarum (yes/no/unknown)) and *a history of*

depression (yes/no).

2.3. Statistical analyses

Bivariate associations between the three SMU variables with depressive symptoms at 12, 20 and 28 weeks of pregnancy were examined using non-parametric Spearman correlations. To determine different longitudinal trajectories (classes) of depressive symptoms during pregnancy, Mplus version 8.5 was used to perform growth mixture modeling (Muthén and Muthén, 1998–2017). Since the EDS scores were positively skewed, with many total scores equal to zero, maximum likelihood estimation with robust standard errors (MLR) was used. After a one-class model, models with increasing numbers of classes were fitted. Several fit indices were applied to obtain the optimal number of classes: Bayesian Information Criterion (BIC), Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT), Bootstrapped Likelihood Ratio Test (BLRT) (Jung and Wickrama, 2008; Nylund et al., 2007), as well as the entropy (Collins and Lanza, 2009), parsimony and interpretability. The reference category was defined as the class with the highest number of women.

Three multinomial logistic regression analyses were then performed in R (version 3.6.3) with the determined trajectories of depressive symptoms as the outcome variable and one of the three SMU variables as the predictor (Model 1: SMU Time, Model 2: SMU Frequency, Model 3: BSMAS). After investigating the unadjusted models, the following seven covariates were entered into the models: *age, level of education, parity, unplanned pregnancy, previous miscarriage/abortion, obstetric complication* and *history of depression*. Data are presented as odds ratios with 95 % confidence intervals.

Finally, to gain insight into the clinical relevance of the effect of problematic use of social media, we used the cut-off scores of the BSMAS (scoring 3 or above on at least four of the six items), to create two social media groups: potentially addicted versus non-addicted.

3. Results

3.1. Social media use during pregnancy

Participant characteristics and mean variable scores are presented in Table 1. On average, women participating in this study (N = 697) spent 1.6 h a day, and 19.5 times a week on social media and had a mean BSMAS score of 9.6 (SD = 3.3).

Correlations between the SMU variables and EDS total scores at all trimesters variables are shown in Table 2. The correlations showed significant positive associations between the BSMAS index of problematic SMU with EDS scores at all trimesters (all $P < .001$). However, SMU Time and SMU Frequency were not significantly correlated with the EDS scores. Furthermore, all SMU variables were significantly and positively inter-correlated (all $P < .001$).

3.2. Trajectories of depressive symptoms during pregnancy

Based on the fit indices for growth mixture modeling, a three-class growth mixture model provided the best representation of the trajectories of depressive symptom levels during pregnancy (see eTables 1 and 2 in the Supplement).

Fig. 1 shows the mean EDS scores for the three trajectories of depressive symptoms during pregnancy. The first class is referred to as *the low stable class* (N = 489, 70.2 %) and represents the reference group. Women in this class showed a low and stable course of depressive symptoms during pregnancy (mean EDS scores ranged between 2.8 and 3.0). In this class, at 12, 20 and 28 weeks of pregnancy, 0.0 %, 0.6 %, and 0.4 %, scored above the cut-off of the EDS, respectively. The second class, *the intermediate stable class*, consisted of 183 women (26.3 %). These women had an intermediate level of depressive symptoms throughout pregnancy (mean EDS scores ranged between 8.4 and 8.8).

Table 1
Characteristics of the participating women (N = 697).

	No. (%)	Mean (SD)	Range
Demographics			
Age (years)		31.0 (3.6)	19–42
High level of education[a]	492 (70.6)		
Employment	669 (96.0)		
Having a partner	687 (98.6)		
Pregnancy related			
Multiparity	329 (47.2)		
Unplanned pregnancy	50 (7.2)		
Previous miscarriage/abortion	195 (28.0)		
Obstetric complication[b]	122 (17.5)		
Psychological features			
History of depression	81 (11.6)		
EDS			
12 weeks	697 (100.0)	4.8 (4.3)	0–23
20 weeks	552 (79.2)	4.6 (4.2)	0–24
28 weeks	423 (60.7)	5.0 (4.3)	0–25
Social media			
SMU Time[c] at 12 weeks	697 (100.0)	1.6 (1.1)	0–7
SMU Frequency[d] at 12 weeks	697 (100.0)	19.5 (11.5)	0–35
BSMAS at 12 weeks	697 (100.0)	9.6 (3.3)	6–21

SD, standard deviation; EDS, Edinburgh Depression Scale; SMU, Social Media Use.
[a] Bachelor's degree or higher.
[b] Including intrauterine growth restriction, pre-eclampsia, and diabetes gravidarum.
[c] Assessed in hours per day.
[d] Measuring site visits per week.

Table 2
Non-parametric Spearman correlations between intensity of social media use (time and frequency) and problematic social media use (BSMAS) and depressive symptoms at 12, 20 and 28 weeks of pregnancy.

	EDS 12	EDS 20	EDS 28	SMU Time	SMU Frequency
SMU Time	0.058	0.048	−0.004	.	
SMU Frequency	0.029	0.042	0.002	0.656***	.
BSMAS	0.190***	0.245***	0.170***	0.456***	0.407***

BSMAS, Bergen Social Media Addiction Scale; SMU, Social Media Use; EDS, Edinburgh Depression Scale.
*** $P < .001$.

In this class, at 12, 20 and 28 weeks of pregnancy, 30.1 %, 26.8 %, and 23.5 %, scored above the cut-off of the EDS, respectively. Women in the third class (N = 25, 3.6 %), *the high stable class*, showed high levels of depressive symptoms at the first trimester which persisted over time (mean EDS scores ranged between 15.1 and 16.9 across the three trimesters). In this class, at 12, 20 and 28 weeks of pregnancy, 88.0 %, 68 %, and 56 %, scored above the cut-off of the EDS, respectively.

In each trimester of pregnancy, mean depression scores were significantly different between the three classes (ANOVA: F(2, 420 to 694) = 337.6 to 461.2, all $p < .001$, $\eta^2 = 0.57$ to 0.62 (large effect sizes)). The mean depression scores were significantly higher in both the intermediate stable and high stable class, in comparison to the low stable class for each trimester (Post-hoc Tukey: all $p < .001$).

3.3. Social media use and trajectories of depressive symptoms

The participating women belonging to the low stable, intermediate stable and high stable class spent 1.5, 1.7 and 2.0 h a day and 19.0, 20.2 and 23.9 times a week on social media, respectively. Furthermore, the

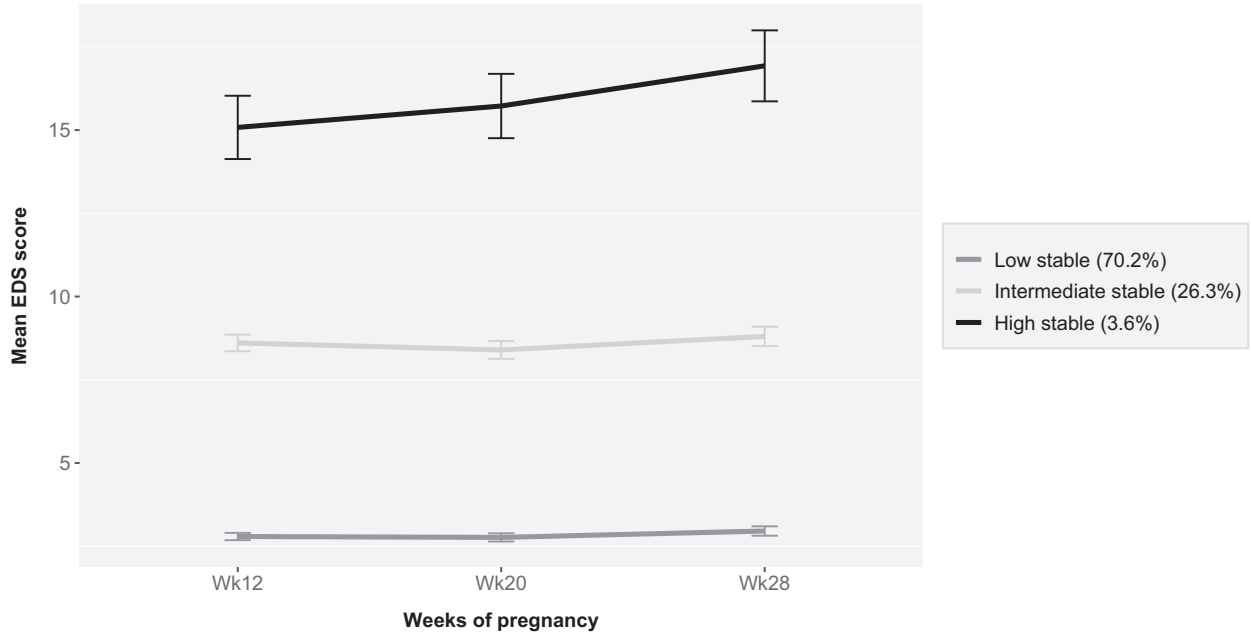


Fig. 1. Mean scores on the Edinburgh Depression Scale for the different longitudinal trajectories of depressive symptoms during pregnancy (N = 697).

mean BSMAS scores were 9.0 for the low stable class, 10.7 for the intermediate stable class, and 12.6 for the high stable class.

3.3.1. Intensity of social media use

For SMU time, the unadjusted estimates were OR = 1.16, 95 % CI [0.99, 1.35], $P = .062$ for the intermediate stable depression class and OR = 1.42, 95 % CI [1.03, 1.94], $P = .030$ for the high stable class, compared to the low stable class (reference outcome category). After adjusting for the seven covariates (Table 3, Model 1), SMU Time remained significantly associated with higher odds of belonging to the high stable class (OR = 1.51, 95 % CI [1.08, 2.12], $P = .017$) compared to the odds of belonging to the low stable class.

For SMU Frequency, the unadjusted estimates were OR = 1.01, 95 % CI [0.99, 1.02], $P = .219$ and OR = 1.04, 95 % CI [1.002, 1.08], $P = .038$ for the intermediate stable class and the high stable class, respectively, compared to the low stable class. After including the seven covariates in the model (Table 3, Model 2), SMU Frequency remained significantly associated with higher odds of belonging to the high stable class (OR = 1.05, 95 % CI [1.01, 1.09], $P = .019$) compared to the odds of belonging to the low stable class.

Table 3
Multinomial logistic regression with trajectories of depressive symptoms during pregnancy as the dependent variable and social media variables (BSMAS, SMU Time, SMU Frequency) as the independent variables (N = 697).

	Intermediate stable (26.3 %) vs. Low stable (70.2 %)			High stable (3.6 %) vs. Low stable (70.2 %)		
	OR	95 % CI	*P*-value	OR	95 % CI	*P*-value
SMU Time[a]	1.16	[0.98, 1.37]	0.093	1.51	[1.08, 2.12]	**0.017**
SMU Frequency[b]	1.01	[0.99, 1.03]	0.231	1.05	[1.01, 1.09]	**0.019**
Problematic SMU (BSMAS)[c]	1.17	[1.11, 1.23]	**<0.001**	1.31	[1.17, 1.46]	**<0.001**

BSMAS, Bergen Social Media Addiction Scale; SMU, Social Media Use; OR, Odds Ratio; CI, Confidence Interval.
Social media variables were assessed in separate regression models. All models were adjusted for *age, level of education, parity, unplanned pregnancy, previous miscarriage/abortion, obstetric complication and history of depression.*
Bold: significance as defined by $P < .05$.
[a] Model 1, SMU Time (assessed in hours per day) as independent variable.
[b] Model 2, SMU Frequency (site visits per week) as independent variable.
[c] Model 3, Problematic SMU (assessed using the BSMAS) as independent variable.

3.3.2. Problematic social media use

The unadjusted estimates were OR = 1.17, 95 % CI [1.11, 1.23], $P < .001$ per scale unit for the intermediate stable class and OR = 1.33, 95 % CI [1.19, 1.47], $P < .001$ for the high stable class, compared to the low stable class. After adjustment for the covariates (Table 3, Model 3), higher scores on the BSMAS remained significantly associated with higher odds of belonging to the intermediate stable class (OR = 1.17, 95 % CI [1.11, 1.23], $P < .001$) and the high stable class (OR = 1.31, 95 % CI [1.17, 1.46], $P < .001$), using the low stable class as reference.

3.3.3. Potential social media addiction

According to the cut-off for problematic SMU, 44 (6.3 %) of the 697 women were potentially addicted to social media. Furthermore, 16 (3.3 %) women from the low stable class scored above the cut-off for problematic SMU, 18 (9.8 %) from the intermediate stable class and 10 (40 %) from the high stable class ($\chi^2(2) = 59.5$, $P < .001$). Fig. 2 shows the distribution of BSMAS cut-off scores stratified according to the trajectories of depressive symptoms during pregnancy.

4. Discussion

The current study aimed to investigate whether the intensity of prenatal social media use and problematic social media use were associated with trajectories of depressive symptoms during pregnancy. Three trajectories of depressive symptoms during pregnancy were identified: a low stable class (N = 489, 70.2 %), an intermediate stable class (N = 183, 26.3 %), and a high stable class (N = 25, 3.6 %). Our findings showed that pregnant women that used social media for more hours and more frequently were more likely to belong to the high stable depressive symptoms class. In addition, those expectant mothers with problematic SMU were more likely to belong to the intermediate or high stable depressive symptom class. Taken together, more intense and problematic SMU in pregnant women was associated with higher depressive symptom levels throughout pregnancy.

Our results are in line with previous work in non-pregnant samples.

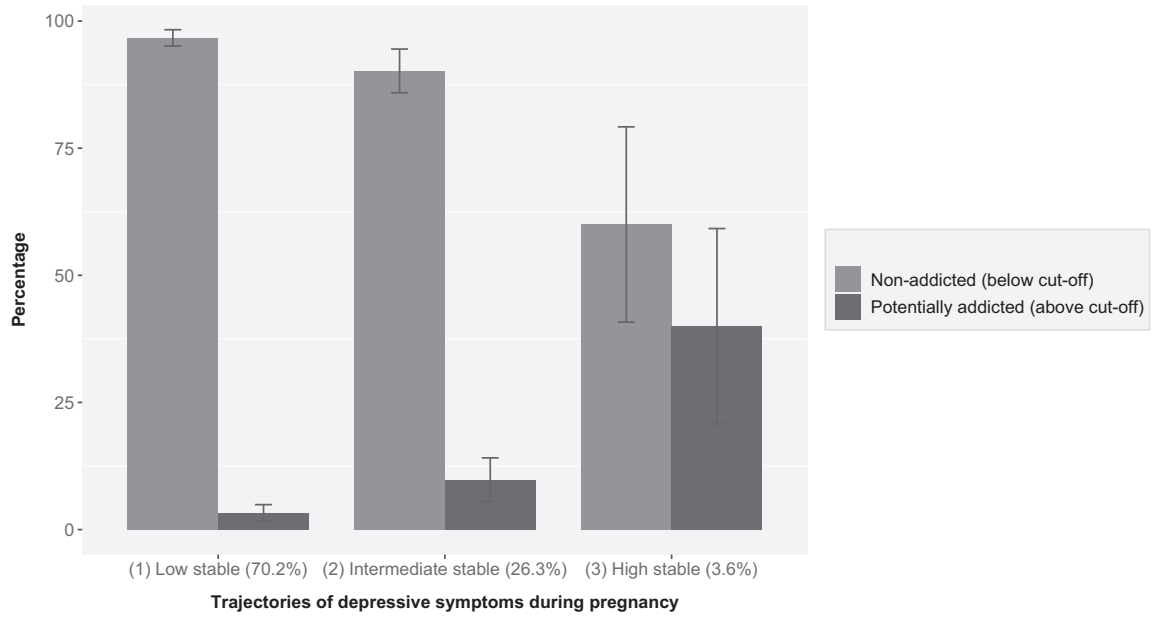


Fig. 2. Distribution of BSMAS cut-off scores stratified according to trajectories of depressive symptoms during pregnancy. Cut-off +: scoring 3 or above on at least four of the six BSMAS items, BSMAS; Bergen Social Media Addiction Scale.

These studies also found that problematic SMU was associated with more mental health problems in adolescents (Boer et al., 2021; Boer et al., 2020) and adults (Shensa et al., 2017). However, the majority of previous studies found no or weak associations with intensity of SMU (Boer et al., 2021; Boer et al., 2020; Shensa et al., 2017). In contrast, the current study did find an association between intensity of SMU and higher levels of depressive symptoms. It could be that the association between intensity of SMU and depressive symptoms is unique to our sample of pregnant women. According to the *motherhood constellation theory* of Stern (2018), pregnant women develop a different mental organization in which the (unborn) child is the most prominent. An expectant mother's interest shifts to themes concerning motherhood and the baby (Stern, 2018). It could therefore be that pregnant women use social media more often to look up information and reassurance regarding their pregnancy, motherhood, and the baby, which might be helpful but could also induce stress. In contrast, non-pregnant (young) adults will probably use social media more often for fun and entertainment (Kircaburun et al., 2020). Future in-depth investigation of the motives of pregnant women to use social media would be necessary to validate this theory.

While our results suggest that SMU can have negative consequences for pregnant women's mental wellbeing, it is important to note that SMU during pregnancy may also be helpful for some pregnant women. Pregnancy can be a challenging period, especially for first-time mothers. Recent literature that focused on the motivation of women to use social media during the perinatal period found that the main reasons are social support, emotional support, and information seeking (Archer and Kao, 2018; Smith et al., 2020). Many women use the internet for questions and advice related to pregnancy and parenting and to be in contact with their online friends as a form of social support (Baker and Yang, 2018). Thus, finding support and information online could be helpful for pregnant women, but it can be speculated that SMU could become problematic when information seeking becomes excessive and/or when reassurance is not successful. Future in-depth investigation of the underlying reasons and motivations for *problematic* SMU during pregnancy should be conducted, for example using a qualitative interview approach.

The current study has several strengths and limitations. Firstly, the conceptualization of SMU in this study is unique, since only few studies have assessed both intensity and problematic SMU, even in non-pregnancy samples (Boer et al., 2021; Boer et al., 2020; Shensa et al., 2017). Secondly, the longitudinal design of this study made it possible to measure trajectories of depressive symptoms. Thirdly, the study has a relatively large sample size (N = 697), which is required for running advanced statistical methods to identify trajectories. This study also has some limitations. Due to the study design, the current study does not allow us to draw conclusions about causality. Furthermore, the group sizes of the three trajectories of depressive symptoms during pregnancy differed considerably (low stable class (N = 489, 70.2 %), intermediate stable class (N = 183, 26.3 %), and high stable class (N = 25, 3.6 %)), which might have influenced the bias of the results. Additionally, data were collected during the COVID-19 pandemic which may have influenced both SMU and depressive symptoms. Increased fear of the corona virus has been related to an increase in searching for information via social media (Mertens et al., 2020). Moreover, the COVID-19 pandemic showed to have a negative impact on depressive symptoms in pregnant women (Campos-Garzón et al., 2021; Fan et al., 2021; Vacaru et al., 2021). Nevertheless, a recent report from the current sample showed that while pregnancy-specific distress during pregnancy increased during the pandemic, depressive symptoms did not show a significant increase (Boekhorst et al., 2021). Another limitation is that SMU was measured by self-report and thus, relied on the estimates of participants, which may have caused retrospective bias (Seabrook et al., 2016). Future research on SMU should use more direct methods to register SMU for more objective results, such as experience sampling methods (Seabrook et al., 2016).

In conclusion, the results of our study showed an association between both intensity of SMU and problematic SMU and higher levels of depressive symptoms during pregnancy. We therefore advise healthcare professionals to pay more attention to and discuss SMU (e.g., midwifes during regular appointments), in addition to the known risk factors which have been previously and consistently reported in research (see Biaggi et al. (2016 for extensive review)). It is important that future research identifies the type of support that is needed for pregnant women with both more intense and problematic SMU, so that healthcare professionals can adequately accommodate to women's needs. This is especially important since perinatal depressive symptoms do not only have an impact on the mother but could also have a negative impact on fetal and child development (Grote et al., 2010; Liu et al., 2017). Furthermore, depressive symptoms during pregnancy have been

associated with parental stress up to six months postpartum and sub-optimal mother-to-infant bonding (Misri et al., 2010; Tichelman et al., 2019). Still, more research is necessary to determine the causal relationship between SMU and depressive symptoms before clear clinical implications and guidelines can be drafted.

Role of funding source

This project was supported by Tilburg University. MvdH is supported by the Dutch Research Council (NWO), Veni.VI.191G.025.

CRediT authorship contribution statement

LM and LH wrote the initial draft of the manuscript, MvdH, EC, WK, VP and MB contributed to writing. LM and LH ran the statistical analyses on the data. LM, LH and MB reviewed the results and contributed to interpretation. VP conceived the original idea of the longitudinal study. VP and MB supervised the project. All authors reviewed the final draft of the manuscript.

Declaration of competing interest

All other authors declare that they have no conflicts of interest.

Acknowledgements

The authors thank all the midwives for recruiting the participants and the pregnant women for their collaboration.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2023.06.045.

References

Andreassen, C.S., Torsheim, T., Brunborg, G.S., Pallesen, S., 2012. Development of a Facebook Addiction Scale. Psychol. Rep. 110, 501–517.
Andreassen, C.S., Billieux, J., Griffiths, M.D., Kuss, D.J., Demetrovics, Z., Mazzoni, E., Pallesen, S., 2016. The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: a large-scale cross-sectional study. Psychol. Addict. Behav. 30, 252–262.
Archer, C., Kao, K.-T., 2018. Mother, baby and Facebook makes three: does social media provide social support for new mothers? Media Int. Aust. 168, 122–139.
Baker, B., Yang, I., 2018. Social media as social support in pregnancy and the postpartum. Sex Reprod. Healthc. 17, 31–34.
Bennett, H.A., Einarson, A., Taddio, A., Koren, G., Einarson, T.R., 2004. Prevalence of depression during pregnancy: systematic review. Obstet. Gynecol. 103, 698–709.
Bergink, V., Kooistra, L., Lambregtse-van den Berg, M.P., Wijnen, H., Bunevicius, R., van Baar, A., Pop, V., 2011. Validation of the Edinburgh Depression Scale during pregnancy. J. Psychosom. Res. 70, 385–389.
Biaggi, A., Conroy, S., Pawlby, S., Pariante, C.M., 2016. Identifying the women at risk of antenatal anxiety and depression: a systematic review. J. Affect. Disord. 191, 62–77.
Boekhorst, M., Muskens, L., Hulsbosch, L.P., Van Deun, K., Bergink, V., Pop, V.J.M., van den Heuvel, M.I., 2021. The COVID-19 outbreak increases maternal stress during pregnancy, but not the risk for postpartum depression. Arch. Womens Ment. Health 24, 1037–1043.
Boer, M., van den Eijnden, R., Boniel-Nissim, M., Wong, S.L., Inchley, J.C., Badura, P., Craig, W.M., Gobina, I., Kleszczewska, D., Klanšček, H.J., Stevens, G., 2020. Adolescents' intense and problematic social media use and their well-being in 29 countries. J. Adolesc. Health 66, S89–s99.
Boer, M., Stevens, G.W., Finkenauer, C., de Looze, M.E., van den Eijnden, R.J., 2021. Social media use intensity, social media use problems, and mental health among adolescents: investigating directionality and mediating processes. Comput. Hum. Behav. 116, 106645.
Campos-Garzón, C., Riquelme-Gallego, B., de la Torre-Luque, A., Caparrós-González, R. A., 2021. Psychological impact of the COVID-19 pandemic on pregnant women: a scoping review. Behav. Sci. (Basel) 11.
Collins, L.M., Lanza, S.T., 2009. Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences. John Wiley & Sons.
Cox, J.L., Holden, J.M., Sagovsky, R., 1987. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br. J. Psychiatry 150, 782–786.
Fan, S., Guan, J., Cao, L., Wang, M., Zhao, H., Chen, L., Yan, L., 2021. Psychological effects caused by COVID-19 pandemic on pregnant women: a systematic review with meta-analysis. Asian J. Psychiatr. 56, 102533.
Gavin, N.I., Gaynes, B.N., Lohr, K.N., Meltzer-Brody, S., Gartlehner, G., Swinson, T., 2005. Perinatal depression: a systematic review of prevalence and incidence. Obstet. Gynecol. 106, 1071–1083.
Ge, L., Yap, C.W., Ong, R., Heng, B.H., 2017. Social isolation, loneliness and their relationships with depressive symptoms: a population-based study. PLoS One 12, e0182145.
Griffiths, M., 2005. A 'components' model of addiction within a biopsychosocial framework. J. Subst. Abus. 10, 191–197.
Griffiths, M.D., Kuss, D.J., Demetrovics, Z., 2014. Social networking addiction: an overview of preliminary findings. Behav. Addict. 119–141.
Grote, N.K., Bridge, J.A., Gavin, A.R., Melville, J.L., Iyengar, S., Katon, W.J., 2010. A meta-analysis of depression during pregnancy and the risk of preterm birth, low birth weight, and intrauterine growth restriction. Arch. Gen. Psychiatry 67, 1012–1024.
Hussain, Z., Griffiths, M.D., 2018. Problematic social networking site use and comorbid psychiatric disorders: a systematic review of recent large-scale studies. Front. Psychiatry 9, 686.
Jung, T., Wickrama, K.A., 2008. An introduction to latent class growth analysis and growth mixture modeling. Soc. Personal. Psychol. Compass 2, 302–317.
Kelly, Y., Zilanawala, A., Booker, C., Sacker, A., 2018. Social media use and adolescent mental health: findings from the UK millennium cohort study. EClinicalMedicine 6, 59–68.
Kircaburun, K., Alhabash, S., Tosuntaş, Ş.B., Griffiths, M.D., 2020. Uses and gratifications of problematic social media use among university students: a simultaneous examination of the Big Five of personality traits, social media platforms, and social media use motives. Int. J. Ment. Heal. Addict. 18, 525–547.
Lin, L.Y., Sidani, J.E., Shensa, A., Radovic, A., Miller, E., Colditz, J.B., Hoffman, B.L., Giles, L.M., Primack, B.A., 2016. Association between social media use and depression among U.S. young adults. Depress. Anxiety 33, 323–331.
Liu, Y., Kaaya, S., Chai, J., McCoy, D.C., Surkan, P.J., Black, M.M., Sutter-Dallay, A.L., Verdoux, H., Smith-Fawzi, M.C., 2017. Maternal depressive symptoms and early childhood cognitive development: a meta-analysis. Psychol. Med. 47, 680–689.
Lupton, D., Pedersen, S., 2016. An Australian survey of women's use of pregnancy and parenting apps. Women Birth 29, 368–375.
Meems, M., Hulsbosch, L., Riem, M., Meyers, C., Pronk, T., Broeren, M., Nabbe, K., Oei, G., Bogaerts, S., Pop, V., 2020. The Brabant study: design of a large prospective perinatal cohort study among pregnant women investigating obstetric outcome from a biopsychosocial perspective. BMJ Open 10, e038891.
Mertens, G., Gerritsen, L., Duijndam, S., Salemink, E., Engelhard, I.M., 2020. Fear of the coronavirus (COVID-19): predictors in an online study conducted in March 2020. J. Anxiety Disord. 74, 102258.
Meshi, D., Ellithorpe, M.E., 2021. Problematic social media use and social support received in real-life versus on social media: associations with depression, anxiety and social isolation. Addict. Behav. 119, 106949.
Misri, S., Kendrick, K., Oberlander, T.F., Norris, S., Tomfohr, L., Zhang, H., Grunau, R.E., 2010. Antenatal depression and anxiety affect postpartum parenting stress: a longitudinal, prospective study. Can. J. Psychiatr. 55, 222–228.
Müller, K.W., Dreier, M., Beutel, M.E., Duven, E., Giralt, S., Wölfling, K., 2016. A hidden type of internet addiction? Intense and addictive use of social networking sites in adolescents. Comput. Hum. Behav. 55, 172–177.
Muthén, L.K., Muthén, B.O., 1998–2017. Mplus User's Guide, eighth ed. Muthén & Muthén, Los Angeles, CA.
Nandi, A., Beard, J.R., Galea, S., 2009. Epidemiologic heterogeneity of common mood and anxiety disorders over the lifecourse in the general population: a systematic review. BMC Psychiatry 9, 1–11.
Nylund, K.L., Asparouhov, T., Muthén, B.O., 2007. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. Struct. Equ. Model. Multidiscip. J. 14, 535–569.
O'Connor, E., Rossom, R.C., Henninger, M., Groom, H.C., Burda, B.U., 2016. Primary care screening for and treatment of depression in pregnant and postpartum women: evidence report and systematic review for the US preventive services task force. JAMA 315, 388–406.
O'Day, E.B., Heimberg, R.G., 2021. Social media use, social anxiety, and loneliness: a systematic review. Comput. Hum. Behav. Rep. 3, 100070.
Okagbue, H.I., Adamu, P.I., Bishop, S.A., Oguntunde, P.E., Opanuga, A.A., Akhmetshin, E.M., 2019. Systematic review of prevalence of antepartum depression during the trimesters of pregnancy. Open Access Maced J. Med. Sci. 7, 1555–1560.
Pew Research Center, 2021. Social Media Fact Sheet.
Pop, V.J., Komproe, I.H., van Son, M.J., 1992. Characteristics of the Edinburgh Post Natal Depression Scale in the Netherlands. J. Affect. Disord. 26, 105–110.
Pop, V., van Son, M., Wijnen, H., Spek, V., Denollet, J., Bergink, V., 2019. Increase of depressive symptomatology during pregnancy over 25 years' time in four population based cohorts. J. Affect. Disord. 259, 175–179.
Santos Jr., H., Tan, X., Salomon, R., 2017. Heterogeneity in perinatal depression: how far have we come? A systematic review. Arch. Womens Ment. Health 20, 11–23.
Seabrook, E.M., Kern, M.L., Rickard, N.S., 2016. Social networking sites, depression, and anxiety: a systematic review. JMIR Ment. Health 3, e50.
Shensa, A., Escobar-Viera, C.G., Sidani, J.E., Bowman, N.D., Marshal, M.P., Primack, B. A., 2017. Problematic social media use and depressive symptoms among U.S. young adults: a nationally-representative study. Soc. Sci. Med. 182, 150–157.
Shensa, A., Sidani, J.E., Dew, M.A., Escobar-Viera, C.G., Primack, B.A., 2018. Social media use and depression and anxiety symptoms: a cluster analysis. Am. J. Health Behav. 42, 116–128.

Smith, M., Mitchell, A.S., Townsend, M.L., Herbert, J.S., 2020. The relationship between digital media use during pregnancy, maternal psychological wellbeing, and maternal-fetal attachment. PLoS One 15, e0243898.
Stern, D.N., 2018. The Motherhood Constellation: A Unified View of Parent-Infant Psychotherapy. Routledge.
Tichelman, E., Westerneng, M., Witteveen, A.B., van Baar, A.L., van der Horst, H.E., de Jonge, A., Berger, M.Y., Schellevis, F.G., Burger, H., Peters, L.L., 2019. Correlates of prenatal and postnatal mother-to-infant bonding quality: a systematic review. PLoS One 14, e0222998.
Vacaru, S., Beijers, R., Browne, P.D., Cloin, M., van Bakel, H., van den Heuvel, M.I., de Weerth, C., 2021. The risk and protective factors of heightened prenatal anxiety and depression during the COVID-19 lockdown. Sci. Rep. 11, 20261.
Woody, C.A., Ferrari, A.J., Siskind, D.J., Whiteford, H.A., Harris, M.G., 2017. A systematic review and meta-regression of the prevalence and incidence of perinatal depression. J. Affect. Disord. 219, 86–92.
Yang, K., 2018. Causal conditions for loneliness: a set-theoretic analysis on an adult sample in the UK. Qual. Quant. 52, 685–701.