

# Novel risk factors for perinatal maternal mental health problems



Lotte Muskens



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The work presented in this thesis was supported by Tilburg University.

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**Cover design:** C. Parera | [stunnenberg.nl](https://stunnenberg.nl)

**Layout and design:** K. Jansen | [persoonlijkproefschrift.nl](https://persoonlijkproefschrift.nl)

**Printing:** Ridderprint | [ridderprint.nl](https://ridderprint.nl)

ISBN: 978-94-6506-015-6

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## **Novel risk factors for perinatal maternal mental health problems**

Proefschrift ter verkrijging van de graad van doctor aan Tilburg University op gezag van de rector magnificus, prof. dr. W.B.H.J. van de Donk, in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de Aula van de Universiteit op vrijdag 28 juni 2024 om 13.30 uur

door

**Lotte Muskens**

geboren te 's-Hertogenbosch

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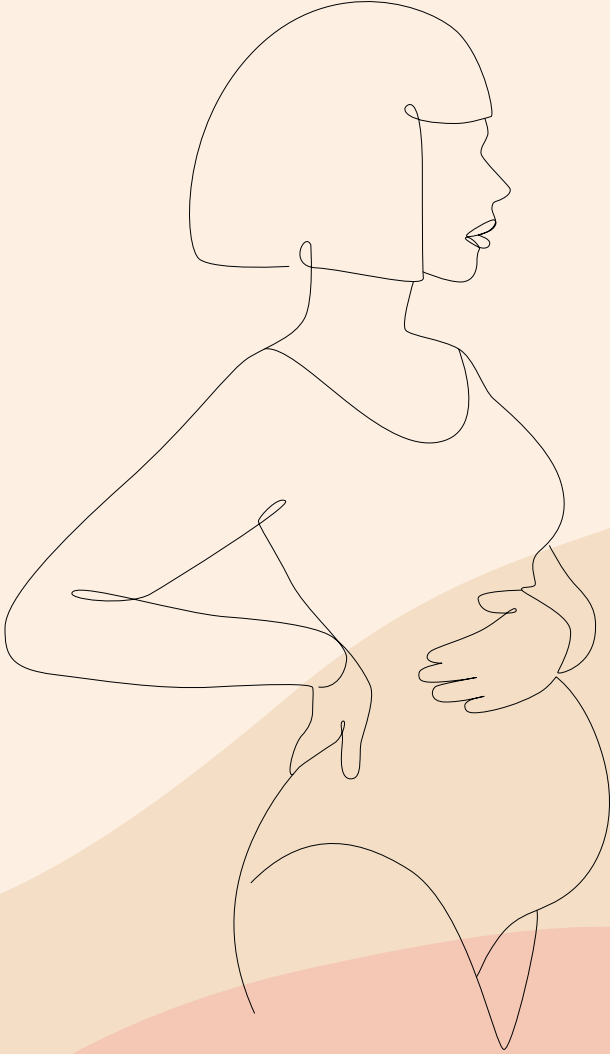
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# Chapter 1

**General introduction**

The perinatal period is associated with multiple challenges for mother and child. These include the positive aspects of new life but also vulnerabilities related to physical and mental wellbeing for mother, child, and their significant others. This period is characterized by multiple physical, psychological, and social changes, many of them associated with elevated levels of psychological distress<sup>1-5</sup>. Many risk factors for psychological distress during the perinatal period have been identified, including lower education, lower income, smoking, previous history of mental health problems, having no partner, unplanned pregnancy, and pregnancy loss<sup>6-12</sup>. As the world is rapidly changing, pregnant women face additional challenges related to changes in social expectations, technological innovations, and new ways of accessing information and social contacts via digital channels. Given these various changes, the current thesis focuses on the novel potential risk factors for maternal mental health problems during the perinatal period, such as *unplanned pregnancy*, *social media use* and challenges related to the *COVID-19 pandemic*.

In **Section 1** of this General Introduction, the concept of maternal mental health during the perinatal period is discussed, as well as the novel risk factors researched in this thesis. **Section 2** provides an overview of the measures of maternal mental health, discusses the study samples included in this thesis, and describes the statistical analyses used to investigate the novel risk factors for perinatal mental health problems. In **Section 3**, the aims and outline of this thesis are described.

## **Section 1 – Background**

### **1.1 Maternal mental health during the perinatal period**

This section provides a brief overview of maternal mental health during the prenatal and postpartum period, followed by a description of novel risk factors for maternal mental health problems during the perinatal period (i.e., unplanned pregnancy, maladaptive social media use, and consequences of the COVID-19 pandemic).

#### ***1.1.1 Mental wellbeing during pregnancy***

Psychological distress is common during pregnancy, with reported prevalence estimates of depressive symptoms during pregnancy ranging between 11% and 18%<sup>2,3,5</sup> and anxiety symptoms between 18% and 25%<sup>1</sup>. Psychological distress can be defined as: *“a state of emotional suffering characterized by symptoms of depression*

and anxiety, sometimes accompanied by somatic symptoms”<sup>13</sup>. Within this concept, the current thesis focuses on depressive symptoms during the perinatal period. Additionally, this thesis investigates pregnancy-specific distress, defined as: “a woman’s response to the transition to motherhood, which includes changes to her body, roles, relationships, and social circumstances; birth experiences; and the demands, challenges, losses, and gains associated with being a (new) mother”<sup>14</sup>. Pregnant women can, for example, feel distress due to fears and worries related to the health of the fetus and related to childbirth, but also related to bodily changes, such as weight gain, striae gravidarum, and breast swelling<sup>15,16</sup>. Perinatal depressive symptoms and distress can affect both the mother and her unborn child, since they have been associated with severe obstetric complications, including pregnancy-induced hypertension, preterm birth, and low birth weight<sup>17-23</sup>. Importantly, perinatal depressive symptoms and distress also potentially impact the long-term development of the child, as it has been linked to impaired neurodevelopment, worse cognitive development, and psychopathology in later life<sup>24-27</sup>.

### **1.1.2 Mental wellbeing during the postpartum period**

The exact timeframe referring to the postpartum period is somewhat unclear. In the literature, several timeframes have been used over the years. In this thesis, as in most studies, the postpartum period is referred to as the first twelve months after childbirth. Although it is beyond the scope of this thesis to discuss all mood problems which could occur during the perinatal period, a general classification includes: *postpartum blues*, *postpartum depression*, and *postpartum psychosis*.

Postpartum blues occur in the first week postpartum and include symptoms such as anxiety, emotional lability, irritability and crying, and affect up to 80% of childbearing women<sup>28</sup>. Postpartum depression affects around 15% to 25% of postpartum women<sup>4</sup>. Women who have already experienced increased levels of depression during pregnancy, are at an even greater risk for developing postpartum depression<sup>29,30</sup>. Postpartum depression has been included in the DSM-5 as a major depressive disorder with an onset during pregnancy or within the first four weeks after childbirth<sup>31</sup>. However, this time period of four weeks is questionable, as empirical evidence is lacking. Studies have shown onsets of depression *after* four weeks postpartum, up to twelve months after childbirth<sup>12,32,33</sup>. The studies in the current thesis focus on postpartum depression in the first twelve months after

childbirth. Postpartum depression has been linked to various negative outcomes, such as greater difficulties with social and partner relationships and suboptimal mother-to-infant bonding<sup>34,35</sup>. Postpartum psychosis is the most severe postpartum disorder with incidence ranging between 0.89 and 2.6 in 1000 births<sup>36</sup>. Postpartum psychosis has not been recognized by the DSM-5 as a separate disorder. Women with postpartum psychosis suffer from, among others, mood swings, hallucinations, delusions, and behavioral changes.

## **1.2 Novel risk factors for maternal mental health problems during the perinatal period**

There are multiple well studied risk factors for mental health problems during the perinatal period, such as unemployment, low educational level, history of depression, low levels of partner and social support, poor lifestyle habits, and negative life events<sup>6-12</sup>. This thesis will discuss several novel risk factors for maternal mental health problems: unplanned pregnancy, social media use, and the COVID-19 pandemic.

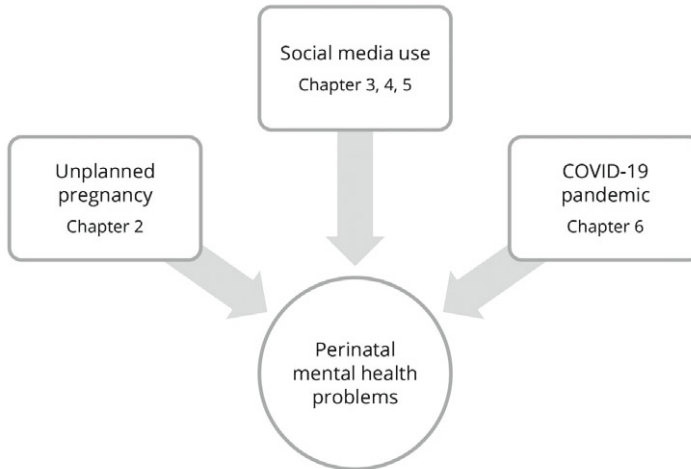
While unplanned pregnancy has shown to be a risk factor for perinatal depressive symptoms, there is a lack of studies that focus on the association between unplanned pregnancy and depressive symptoms throughout the entire perinatal period, from the beginning of pregnancy up to 12 months postpartum. It is important to investigate this longitudinal course since depressive symptoms are variable over time<sup>37</sup>. Furthermore, it is important to research the impact of unplanned pregnancies in the literature, since the obstetric care for pregnant women differs greatly in different countries.

Over the years, there has been a significant increase in the intensity of prenatal depressive symptoms, however, protective factors, such as, employment, higher educational level, smoking and alcohol use, have improved<sup>38</sup>. A possible explanation for this paradox might be that the prevalence of social media usage among young adults, including pregnant women, increased<sup>38,39</sup>. In this thesis it is investigated whether intense and problematic social media use is associated with higher levels of depressive symptoms during pregnancy.

The COVID-19 pandemic has had a great impact on pregnant and postpartum women, which are already more vulnerable. The many changes in obstetric care, feelings of

anxiety and uncertainties during this period of time might have caused increases in distress during the perinatal period.

The novel risk factors for maternal mental health problems during the perinatal period investigated in this thesis, are described in more detail below. See **Figure 1** for a graphical overview of these risk factors and the corresponding chapters.



**Figure 1.** Overview of the novel risk factors of perinatal mental health problems

### 1.2.1 *Unplanned pregnancy*

The percentage of unplanned pregnancies in the Netherlands is substantially lower than in other countries, such as the USA (45% unintended)<sup>40</sup> and UK (16.2% unplanned, 29.0% ambivalent)<sup>41</sup>. In 2016, the percentage of women who reported an unplanned pregnancy in the Netherlands was 3%<sup>42</sup> and the percentage of women who were at risk of an unplanned pregnancy in the Netherlands in 2022 was 8.4%<sup>43</sup>. These differences between countries can be partially explained by the characteristics of obstetric care in the Netherlands versus other countries. Specifically, in the Netherlands, women have the option to terminate an unplanned *and* unwanted pregnancy. This decision is usually made before 8-10 weeks of gestation<sup>44</sup>. Most women with an unplanned *and* unwanted pregnancy have therefore already made the decision for an abortion of the pregnancy before they have their first appointment with the community midwife, which usually takes place between 8 and 12 weeks gestation. Over the years the number of abortions in the Netherlands has increased, with a 15% rise

between 2021 (28.089) and 2022 (32.348)<sup>44</sup>. These terminated pregnancies can be described as unplanned *and* unwanted. Because most unplanned pregnancies in the Netherlands, which are not terminated, are unplanned but *not* unwanted, it is even more important to investigate the possible long-lasting negative impact of an unplanned pregnancy on a woman's perinatal mental health. This has so far been understudied in the literature, even though it might still be an important contemporary risk factor for perinatal mental health problems. For that reason, in **Chapter 2**, the association of unplanned pregnancy with perinatal depression is investigated longitudinally.

### 1.2.2 *Social media use*

Social media use during pregnancy can be very beneficial and helpful for women to cope with the multiple physical, psychological, and social changes that occur during pregnancy. Social media use can provide emotional and social support for pregnant women<sup>45-47</sup>, but little is known about the possible negative effects of social media use on the mental health of pregnant women. One study found that digital media use by pregnant women was associated with more negative affect, self-criticism, and lower quality of life<sup>47</sup>. Research in non-pregnant populations even showed an association between excessive social media use and depressive symptoms<sup>48-53</sup>. However, social media use as a possible risk factor for more depressive symptoms during pregnancy has not yet been investigated. In **Chapter 3** of this thesis this association is investigated. Furthermore, it is important for healthcare professionals to know during which trimester of pregnancy women are more vulnerable to the possible negative influences of social media use. This might help them in their timing and frequency of asking pregnant women about their social media use during pregnancy. During the first trimester of pregnancy, pregnant women might use more social media for support and information to answer their questions<sup>54,55</sup>. In the third trimester, women might also use more social media, for example because of reduced mobility and changes in social and work-related activities. At the end of pregnancy, women might use more social media to compensate for having less in-person contacts<sup>56</sup> and to seek information and support regarding labor and childbirth<sup>55</sup>. The intensity of social media use (time and frequency) and problematic social media use, throughout pregnancy is investigated in **Chapter 4**. It is important to understand the exact pathways from maladaptive social media use to mental health problems in pregnant women. It is crucial to know what motivates women to use social media

during pregnancy and how their thoughts, feelings, and emotions are affected by the use of it; this issue is addressed in a qualitative study in **Chapter 5**.

### **1.2.3 The COVID-19 pandemic**

The COVID-19 pandemic constituted a worldwide outbreak of the coronavirus, an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. The first cases of this new coronavirus, known as nCoV, were identified in China in December 2019. Subsequently, the virus quickly spread to various other countries around the world. In response to the rapid global spread of the virus, the World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and officially classified the outbreak as a pandemic on March 11, 2020. The pandemic has had an enormous impact on society, and consequently also on pregnant and postpartum women. There were substantial changes in obstetric care, such as less face-to-face appointments with the community midwives<sup>57</sup>. Also, little was known about the impact of the virus for pregnant women and their fetus. Pregnant women had to deal with the anxiety of infection without knowing the actual impact of it on their unborn child. Furthermore, there were also many more uncertainties, such as not knowing whether the partner was allowed to be present at delivery. Many pregnant and postpartum women experienced social isolation due to the social distancing guidelines<sup>58,59</sup>. Pregnant women were not able to bond with other pregnant women, and postpartum women were often not able to show their newborn to family and friends. They also could not always get the physical support they needed, while for example professional caregivers were also not allowed to be at the homes of postpartum women to help them during the first week after childbirth. All these COVID-19-related changes and uncertainties might have increased perinatal mental health problems. In **Chapter 6**, the impact of the COVID-19 pandemic on pregnancy-specific distress and depression during the perinatal period is investigated, within a study design in which the recruitment was performed before, during, and after the COVID-19 pandemic.

## Section 2 – Methodology

### 2.1 Assessment of maternal mental health

This section gives an overview of the assessment of maternal mental health, discusses the study samples included in this thesis, and describes the statistical analyses used in the current thesis.

#### 2.1.1 Depression

Depression can be assessed in multiple ways. First of all, depression can be measured as a syndrome by using a diagnostic psychiatric interview, such as the Composite International Diagnostic Interview (CIDI) or the Structural Clinical Interview (SCID)<sup>60,61</sup>. However, in studies with large samples sizes, as in this thesis, it is not feasible to measure depression by diagnostic interviews. Furthermore, it is recommended by the DSM-5 to assess psychological distress, depression and anxiety, on symptom level instead of using a dichotomous approach<sup>62</sup>. The Hamilton Depression Rating Scale (HDRS) is a widely used clinician-administered depression assessment scale to measure the severity of depressive symptoms<sup>63</sup>. Furthermore, depressive symptoms can also be measured by self-report. The Edinburgh (Postnatal) Depression Scale (E(P)DS) is the most frequently used and validated questionnaire to measure depressive symptoms both during pregnancy and postpartum<sup>64,65</sup>. The Dutch version of the E(P)DS has been shown to be a valid and reliable instrument for use during pregnancy and postpartum<sup>66,67</sup>. In this thesis, the Dutch version of the E(P)DS has been used to assess depressive symptoms in the perinatal period.

#### 2.1.2 Pregnancy-specific distress

The Prenatal Distress Questionnaire (PDQ)<sup>68</sup>, the Cambridge Worry Scale (CWS)<sup>69</sup> and the Tilburg Pregnancy Distress Scale (TPDS)<sup>6</sup>, are well-known validated questionnaires to assess fears and worries, specifically towards pregnancy and early childhood. In this thesis, pregnancy-specific distress was measured using the TPDS, specifically the adapted version of the TPDS<sup>70</sup>. The original TPDS was constructed using focus group interviews with pregnant women, women who recently gave birth, and health-care professionals. Both the original and adapted TPDS consist of two subscales. However, for the adapted version, the first subscale consists of ten items (instead of eleven items) measuring negative affect and the second subscale consists of four items (instead of five items) measuring partner involvement. In the current



thesis only the negative affect subscale of the adapted version of the TPDS was used (TPDS-NA). The subscale includes two subcomponents, namely pregnancy and childbirth. The subcomponent postpartum was omitted in the adapted version. Both the TPDS and the adapted version of the TPDS have been shown to be valid and reliable for measuring pregnancy-specific distress in Dutch pregnant women, and the internal consistency and structural validity of the instrument has been shown to be excellent<sup>16,70-72</sup>. Since the development of the TPDS, it has been used in a wide range of different countries, such as Brazil and South Africa<sup>73,74</sup>, and languages, such as Turkish and Persian<sup>75,76</sup>.

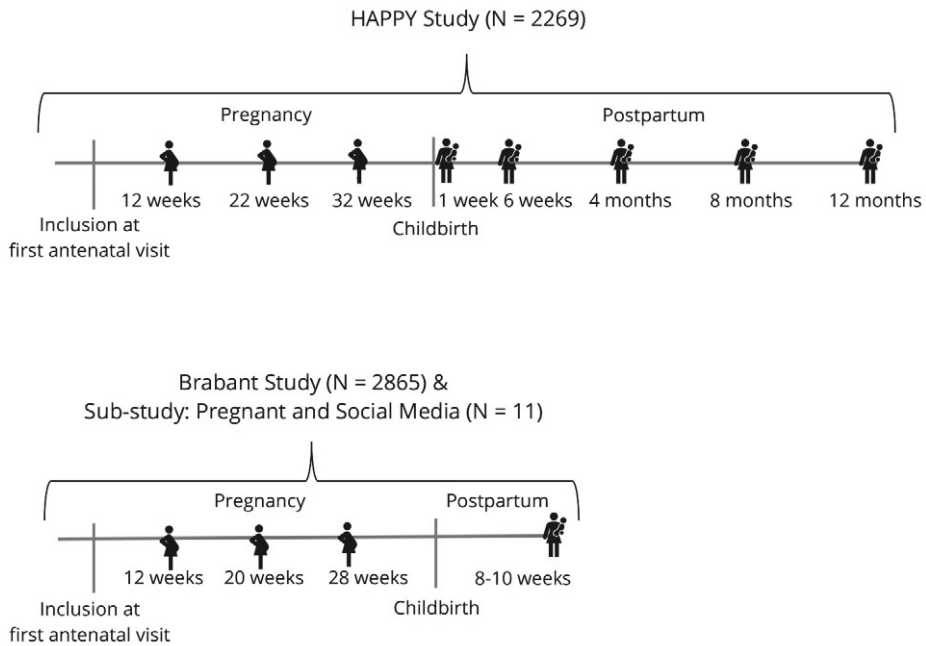
## **2.2 Overview of the study samples used in the current thesis**

Seven longitudinal prospective birth cohort studies have been conducted by our research group in the South-East of the Netherlands, over a period of 25 years<sup>38</sup>. The research in this thesis was conducted using the data of two cohort studies; the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study (2013-2014) and the Brabant Study (BrSt) (2018-2022). These cohorts will be described in detail below.

### ***2.2.1 Cohort 1: Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study***

Between January 2013 and September 2014, 2269 pregnant women were recruited by community midwives at the first antenatal visit in the Eindhoven area, to participate in the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study. The primary aim of the HAPPY study was to examine relationships between various physiological and psychological factors and the well-being of both mothers and infants during pregnancy and the postpartum period. For the design paper of this longitudinal prospective cohort study, please see Truijens et al.<sup>77</sup>. Inclusion criteria were enrollment in the study during the first trimester of pregnancy and Dutch-speaking. Exclusion criteria were multiple pregnancy, a history of chronic disease (e.g., diabetes, thyroid dysfunction), a severe psychiatric disorder (schizophrenia, borderline personality disorder or bipolar disorder), HIV, drug or alcohol addiction, or any other disease treated with medications that are potentially harmful for the fetus and need careful follow-up during pregnancy. The Ethics Review Board of Tilburg University (protocol number EC-2012.25) approved the HAPPY study. The study was additionally reviewed by the Medical Ethical Committee of the Máxima

Medical Centre in Veldhoven, the Netherlands. All participants provided written informed consent prior to taking part in the study. Data from the HAPPY study are used in **Chapter 2**. **Figure 2** shows an overview of the assessment points used in this thesis.



**Figure 2.** Measurement points in the different longitudinal prospective cohort studies

### 2.2.2 Cohort 2: Brabant Study

Between May 2018 and December 2022, 2865 pregnant women were included in the Brabant Study (BrSt). The BrSt is a large longitudinal prospective perinatal cohort study among pregnant women investigating obstetric outcome from a biopsychosocial perspective. The study protocol of this study among pregnant women in the Eindhoven – Tilburg area, has been extensively described by Meems et al.<sup>78</sup>. Inclusion criteria were pregnant women (18+) having their first antenatal visit before 12 weeks of pregnancy and sufficient understanding of the Dutch language. 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, and no internet access. The Brabant Study was approved by the Medical Ethics Committee at the Máxima Medical Centre Veldhoven (NL64091.015.17) and all participants provided written informed consent. Data from the Brabant Study are used in **Chapter 3**, **Chapter 4**, and **Chapter 6**. **Figure 2** shows an overview of the assessment points used in this thesis.

### **2.2.3 Cohort 2a: Brabant Study – Sub-study: Pregnant and Social Media**

A small sub-sample (N = 11) of the BrSt cohort participated in the qualitative sub-study Pregnant and Social Media, between April 2021 and April 2022. Women who scored high on problematic social media use at least once during pregnancy, based on the suggested cut-off of the Bergen Social Media Addiction Scale<sup>79</sup>, were eligible to participate in this sub-study. The participants of this study were interviewed and filled out an online questionnaire to collect data on demographics, their social media use and their mental wellbeing. The sub-study Pregnant and Social Media was approved by the Ethical Review Board of Tilburg University (TSB\_RP527) and all participants provided written informed consent. Data of this study are used in **Chapter 5**. This sub-study is incorporated in **Figure 2**.

## **2.3 Statistical approach and methods used in this thesis**

To extensively investigate maternal perinatal depression and pregnancy-specific distress, we used a multi-method approach, combining quantitative statistical methods and qualitative interview methods. Since multiple studies have shown that pregnancy distress and postpartum depression are not stable but variable over time<sup>37,80-82</sup>, we used statistical methods that are capable of dealing with this variability. In this thesis, repeated measures (RM) ANOVA, linear mixed models (LMM) and growth mixture modeling (GMM) were used to account for the variability of symptoms over time. In short, RM ANOVA compares mean scores of variables across different groups based on repeated observations. LMM model the changes over time with a random parameter, meaning that for every individual a regression line is estimated. Furthermore, when performing LMM, all cases can be included, including those with missing data<sup>83</sup>. Finally, GMM is a more person-centered statistical method, which also allows for missing data. GMM identifies homogenous subgroups, trajectories, or classes, of participants that show similar patterns of symptom change over time.

In addition to quantitative statistical methods, this thesis also includes a chapter using qualitative methods. A qualitative study enables analyses of in-depth interviews to provide greater understanding of the factors underlying a certain problem<sup>84</sup>. In other words, it is often used to establish a more in-depth and comprehensive understanding of a previously found association in quantitative research and to understand the implications of this association. In this thesis, a qualitative approach was used in **Chapter 5** to further investigate the association between social media use and depressive symptoms.

### **Section 3 – Aim and outline of this thesis**

The overall aim of this thesis is to investigate novel risk factors for maternal mental health problems during the perinatal period. **Chapter 2** discusses the importance of unplanned pregnancy as a potential risk factor for depressive symptoms during the perinatal period. **Chapter 3** investigates the association between social media use and depressive symptoms during pregnancy. **Chapter 4** shows the longitudinal course of social media use during pregnancy, from the first to the third trimester. **Chapter 5** further investigates the pathways from social media use to depressive symptoms during pregnancy, using a qualitative approach, by investigating the motives of pregnant women to use social media during pregnancy and its possible positive and negative consequences. **Chapter 6** describes the results of a study investigating the effects of the COVID-19 pandemic on depressive symptoms and pregnancy-specific distress during the perinatal period. The main findings of this thesis are described and discussed in the General Discussion in **Chapter 7**. This chapter also outlines the relevance for future clinical practice and implications for additional research directions in this area which might benefit mental health and wellbeing for mother and child.

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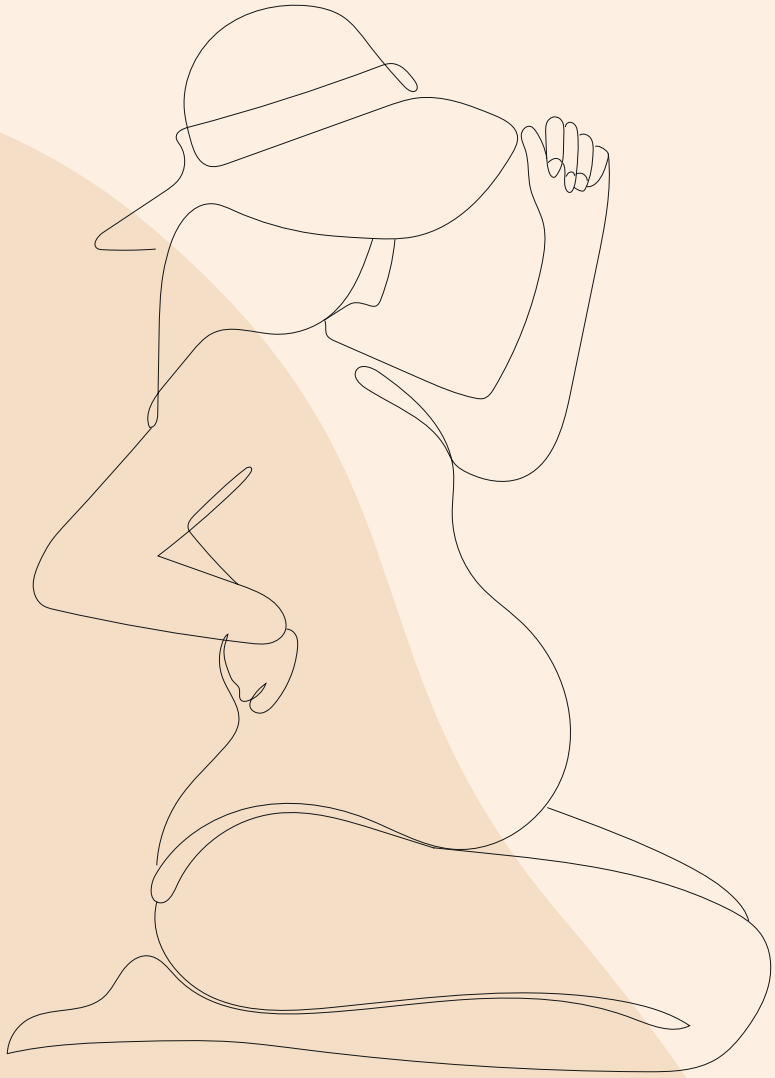
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# Chapter 2

## **The association of unplanned pregnancy with perinatal depression: a longitudinal cohort study**

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## Abstract

**Purpose:** Perinatal depression is common, affecting approximately 7-13% of women. Studies have shown an association between unplanned pregnancy and perinatal depressive symptoms, but many used a cross-sectional design and limited postnatal follow-up. The current study investigated the association of unplanned pregnancy with perinatal depressive symptoms using a longitudinal cohort study that followed women from the first trimester till 12 months postpartum.

**Methods:** Pregnant women (N = 1928) provided demographic and clinical data and information about pregnancy intention at the first trimester. Depressive symptoms were assessed during each trimester of pregnancy and five times postpartum using the Edinburgh Postnatal Depression Scale (EPDS) until 12 months postpartum. Mixed model analyses were used to investigate the association between an unplanned pregnancy and the level of depressive symptoms.

**Results:** Women with an unplanned pregnancy (n = 111, 5.8%) reported persistently higher levels of depressive symptoms during the entire perinatal period compared to women with a planned pregnancy, after adjustment for confounders ( $p < 0.001$ ). However, the *course* of depressive symptom scores over time in women with an unplanned pregnancy was similar to that of women with a planned pregnancy. Lower age ( $p = 0.006$ ), unemployment ( $p = 0.004$ ), and history of depression ( $p < 0.001$ ) were significantly associated with higher levels of perinatal depressive symptoms.

**Conclusions:** An unplanned pregnancy may have a long-lasting negative impact on a woman's perinatal mental health. Therefore, women with an unplanned pregnancy may benefit from systematic follow-up during the perinatal period with contingent mental health support.

## Introduction

Perinatal depression is a common problem affecting approximately 7-13% of women<sup>1-3</sup>. In the current study, the perinatal period was defined as the period during pregnancy up to 12 months postpartum. Perinatal depressive symptoms have not only been linked to severe obstetric complications such as pregnancy-induced hypertension, preterm birth and low birth weight<sup>4-6</sup>, but also to impaired neurodevelopment, lower cognitive development and later psychopathology in the offspring<sup>7,8</sup>. Factors associated with an increased risk of depressive symptoms during the perinatal period include, amongst others, lower level of education, lower income, smoking, previous history of mental health problems, having no partner and pregnancy loss<sup>9-13</sup>.

Unplanned pregnancy is another important predictor of perinatal depression (e.g., Beck<sup>9</sup>; Biaggi et al.<sup>10</sup>; Lancaster et al.<sup>12</sup>). The terms unplanned, unintended, mistimed and unwanted pregnancy are often used interchangeably in the literature, even though there is an important difference between pregnancies that occur two or more years earlier than desired (mistimed), in contrast to pregnancies that are not wanted at all (unwanted)<sup>14,15</sup>. Less planned pregnancies have been related to several factors such as multiparity, low level of education, not having a partner, experiencing intimate partner violence and a history of drug abuse<sup>14</sup>. Furthermore, an unplanned pregnancy seems to negatively impact adequate antenatal care during pregnancy. For example, according to a meta-analysis by Dibaba et al.<sup>16</sup> women with an unplanned pregnancy enter prenatal care later and tend to have fewer prenatal visits. These women also report poorer lifestyle habits during the perinatal period, such as no or lower intake of folic acid before pregnancy and lower vitamin intake during pregnancy, continuation of smoking and alcohol consumption during pregnancy, lower relationship satisfaction and lower levels of social support<sup>14,17</sup>. These observations suggest that women with an unplanned pregnancy might take less care of themselves and their unborn child during the perinatal period.

Furthermore, several studies have confirmed that there is an association between unplanned pregnancy and higher levels of depressive symptoms. For example, Boekhorst et al.<sup>18</sup> concluded that unplanned pregnancies are associated with persistently higher levels of depressive symptoms during the course of pregnancy. Other studies have assessed this association between unplanned pregnancy and

depressive symptoms both during pregnancy and postpartum. For example, a prospective Brazilian study found that women with an unplanned pregnancy were 2.5 times more likely to have a depression during pregnancy and the postpartum period (11 months postpartum), compared to women with a planned pregnancy<sup>19</sup>. In addition, in their systematic review and meta-analysis, Abajobir et al.<sup>20</sup> reported that women with an unintended pregnancy had a two-fold higher risk of developing perinatal depressive symptoms compared to women with an intended pregnancy. Only few studies focused on the possible association between unplanned pregnancy and the occurrence of depressive symptoms throughout the entire perinatal period (during pregnancy up to 12 months postpartum). Christensen et al.<sup>21</sup> showed that unintended pregnancy (defined as intended, mistimed, and unwanted pregnancy) was associated with a pattern of high levels of postpartum (6 weeks to 12 months) depressive symptoms but not a pattern of high symptom levels during the course of pregnancy. Another longitudinal study found that women with an unwanted pregnancy (defined as an unplanned *and* unwanted pregnancy and a negative first reaction to the pregnancy), reported slightly higher levels of depressive symptoms in the earlier phases of pregnancy, but this difference diminished during the follow-up period, both 3-5 days and 6 months postpartum<sup>22</sup>. These two studies both used different instruments, the Beck Depression Inventory-II and the Delusions-Symptoms-States Inventory, to assess depressive symptoms. Furthermore, both studies did not cover the postnatal period from pregnancy until 12 months postpartum. Christensen et al.<sup>21</sup> measured postnatal depressive symptoms during three follow-ups at 6 weeks, 4 months, and 12 months postpartum and Najman et al.<sup>22</sup> used two postnatal measurements, namely at 3-5 days after childbirth and 6 months postpartum.

Some of these studies on the relationship between unplanned pregnancy and perinatal depressive symptoms are limited by a cross-sectional design, in which data is collected during a single moment in time. For example, McCrory and McNally<sup>23</sup> found that unintended pregnancy was associated with increased risk of depression at nine months postpartum and Dibaba et al.<sup>24</sup> found that an unwanted pregnancy is associated with an elevated risk of depression, measured once during pregnancy. On the other hand, with a longitudinal design (e.g., Christensen et al.<sup>21</sup>; Najman et al.<sup>22</sup>) data are collected during repeated observations of the same group, allowing to assess changes in individuals over time. Longitudinal assessments seem of great importance to gain a better understanding of the role of an unplanned pregnancy



in the occurrence of perinatal depressive symptoms, since perinatal depressive symptoms tend to be variable over time<sup>25</sup>. Moreover, a recent study showed that postnatal depression can persist long after birth – for one quarter of women even until 3 years postpartum<sup>26</sup>. To confirm the association between unplanned pregnancy and increased depressive symptom levels in pregnant and postpartum women, a study with sufficient epidemiological power with multiple assessments of depressive symptoms over the entire perinatal period is needed.

The current study assessed the association of unplanned pregnancy with the longitudinal course of depressive symptoms, at all trimesters of pregnancy and five times postpartum during the first postpartum year and tested whether the trajectories of depressive symptoms developed differently for women with an unplanned versus a planned pregnancy. It was hypothesized that women with an unplanned pregnancy report higher levels of depressive symptoms throughout their pregnancy and the postnatal period compared to women with a planned pregnancy.

## **Materials and methods**

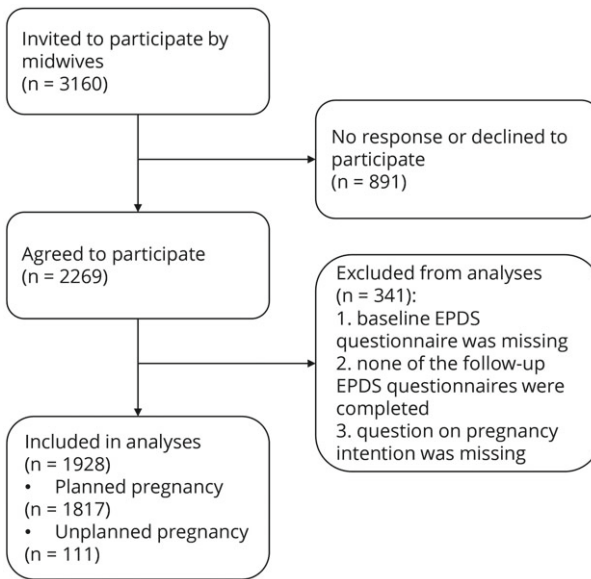
### **Participants and procedure**

The current study is part of a large longitudinal cohort study, the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study<sup>27</sup>. Seventeen participating community midwife practices in the south of the Netherlands invited women to participate during their first antenatal appointment. Inclusion criteria were enrollment during the first trimester of pregnancy and a sufficient understanding of the Dutch language to complete the questionnaires. Exclusion criteria were multiple pregnancy, a history of chronic disease (e.g., diabetes, thyroid dysfunction), a severe psychiatric disorder (schizophrenia, borderline personality disorder or bipolar disorder), HIV, drug or alcohol addiction, or any other disease treated with medications that are potentially harmful for the fetus and need careful follow-up during pregnancy. In total, 3160 pregnant women were invited to participate between January 2013 and September 2014. Of these women, 2269 (72%) participated and provided written informed consent.

In each trimester of pregnancy (12, 22, and 32 weeks of pregnancy) and postpartum (1 week, 6 weeks, 4 months, 8 months, and 12 months postpartum) participating

women received (online) questionnaires. For mixed model analyses, all cases can be included, including those with missing data<sup>28</sup> (see statistical analyses for details). We only included women who: 1) at least completed the Edinburgh Postnatal Depression Scale (EPDS) baseline questionnaire (12 weeks of pregnancy); 2) at least completed one of the follow-up EPDS questionnaires, and 3) answered the question regarding an (un)planned pregnancy. This resulted in a final sample of 1928 women to be included for analyses (Figure 1).

The Ethics Review Board of Tilburg University (protocol number EC-2012.25) approved the HAPPY study. The study was reviewed by the Medical Ethical Committee of the Máxima Medical Centre in Veldhoven. All participants provided written informed consent prior to taking part in this study.



**Figure 1.** Flowchart for the participating women in the current study

*Note.* EPDS, Edinburgh Postnatal Depression Scale

## Measures

### ***Unplanned pregnancy***

Participating women were asked about whether or not the current pregnancy was planned (yes/no), as part of the baseline questionnaire at 12 weeks into pregnancy.

This way of assessment was chosen because of the specifics of the Dutch maternity system. The maternity system in the Netherlands is unique in comparison to other countries. Midwives work as independent healthcare professionals in small practices outside the hospital. 80% of all pregnant women visit the community midwife for their first antenatal control at 8-12 weeks of gestation. However, in case a pregnancy is unplanned and unwanted, and a woman prefers an abortion, she visits a special abortion clinic for help at an earlier stage. As a result, most, if not all women, who eventually visit the midwife for the first antenatal control already have decided to accept the pregnancy, even if it was not planned. This perspective is supported in one of our previous studies conducted in the Netherlands<sup>29</sup>, where this concept was defined as: pregnancy was 1) planned, 2) unplanned but not unwanted, 3) unplanned and unwanted. In this previous study 7.9% of 1213 pregnancies were unplanned. Of these 95 unplanned pregnancies, only two (0.16% of the total group) were not wanted. Therefore, because this is such a small percentage, in the present study we decided to focus on the concept of “unplanned pregnancies” only.

### ***Depressive symptoms***

To assess depressive symptoms during pregnancy, the Dutch version of the Edinburgh Postnatal Depression Scale (EPDS)<sup>30-32</sup> was administered at 12, 22 and 32 weeks of pregnancy, and 1 week, 6 weeks, 4 months, 8 months and 12 months postpartum. The EPDS is a ten-item scale measuring depressive symptoms over the past seven days on a 4-point scale. Total scores range from 0-30, with higher scores indicating greater levels of depressive symptoms. The EPDS has been validated in pregnant women<sup>33</sup>, including a sample of Dutch pregnant women<sup>30</sup>. The EPDS is a valid and reliable instrument, both for use during pregnancy and postpartum<sup>30,32</sup>. A cut-off of  $\geq 13$  was used to categorize women with high levels of depressive symptoms indicating the presence of possible clinical depression, both during pregnancy and postpartum<sup>34</sup>. The current study showed good internal consistency for all eight assessments, with Cronbach's alphas ranging between 0.82 and 0.87.

### ***Covariates***

At 12 weeks of pregnancy, demographic characteristics were collected including age, level of education (high: Bachelor's degree or higher), employment (yes/no) and having a partner (yes/no). Information regarding parity (primiparous/multiparous), previous miscarriage or abortion (yes/no), and a previous history of a depressive

episode (yes/no) were also collected. Lifestyle habits were assessed by self-report at all trimesters of pregnancy, including information on Body Mass Index (BMI), smoking (yes/no) and alcohol consumption during pregnancy.

### **Statistical analyses**

Differences in demographic and clinical characteristics between women with a planned pregnancy versus an unplanned pregnancy were examined using t-tests for continuous variables and Chi-squared ( $\chi^2$ ) tests for categorical variables. For the  $\chi^2$  tests, the phi coefficient was calculated to establish the effect size (0.10 small, 0.30 medium, 0.50 large; Cohen<sup>35</sup>). Furthermore, to examine group differences per time point, t-tests for all eight assessments were executed to test the differences in depressive symptom scores between women with a planned pregnancy versus an unplanned pregnancy. Next, mixed model analyses were used to investigate the association between pregnancy intention (planned versus unplanned) on the individual trajectories of depressive symptom levels over time, adjusting for covariates (i.e., age, BMI, level of education, employment, having a partner, parity, previous miscarriage or abortion, previous history of depressive episode and smoking and alcohol consumption during pregnancy). A “null model” was created to fit the individual trajectories of depressive symptoms. We subsequently created a basic model by adding “time” as a continuous variable and “time” as a random slope. “Time” corresponds to the eight measurements of depressive symptoms throughout pregnancy and the postpartum period. With the random slope of time a regression line is estimated for each participant. Based on Maximum Likelihood methods, the unstructured (UN) covariance matrix fitted the data best. Next, we created a predictor model by adding the variable unplanned pregnancy to the basic model. The next model included all covariates. In the final model we tested the quadratic effect of time (time\*time) and the interaction effects unplanned pregnancy\*time and unplanned pregnancy\*time\*time. With the interaction effect time\*time it is tested whether there is a non-linear, but quadratic change in depressive symptom scores over time. The interaction effect pregnancy\*time tests whether the change in depressive symptom scores over time is different for women with an unplanned pregnancy in comparison to women with a planned pregnancy. And finally, pregnancy\*time\*time is added to the model to test whether the possible quadratic change in depressive symptom scores over time, is different for women with an unplanned pregnancy in comparison to women with a planned pregnancy.

This resulted in a model including a random intercept, a random slope of time, the independent variable unplanned pregnancy plus all covariates, the quadratic effect of time (time\*time) and the interaction effects unplanned pregnancy\*time and unplanned pregnancy\*time\*time.

The Statistical Package for Social Sciences (SPSS version 24.0, IBM, Chicago, Illinois, USA) was used to conduct statistical analyses.

## Results

Table 1 shows the characteristics of both the participating women with an unplanned pregnancy (n = 111, 5.8%) and the comparison group of women with a planned pregnancy (n = 1817, 94.2%). For all significant demographic differences, the effect sizes ranged between small and medium.

**Table 1.** Characteristics of women who reported an unplanned pregnancy compared to those with planned pregnancy (N = 1928).

	Total		Pregnancy intention				P-value
	n (%)	Mean ± SD	n (%)	n (%)	Mean ± SD	χ <sup>2</sup>	
	N = 1928		Unplanned n = 111 (5.8%)		Planned n = 1817 (94.2%)		T-test
Age in years		30.47 ± 3.65		30.43 ± 5.10	30.48 ± 3.55		0.928
Level of education <sup>1</sup>						0.003**	
Low	686 (35.7)		54 (49.1)		632 (34.9)		
High	1233 (64.3)		56 (50.9)		1177 (65.1)		
Paid job	1803 (93.5)		94 (84.7)		1709 (94.1)	<0.001***	
Partner	1906 (98.9)		100 (90.1)		1806 (99.4)	<0.001***	
BMI pre-pregnancy (kg/m <sup>2</sup> )		23.81 ± 3.93		23.87 ± 4.07	23.81 ± 3.92		0.859
Alcohol use during pregnancy	77 (4.2)		7 (6.9)		70 (4.0)	0.166	
Smoking during pregnancy	109 (5.9)		21 (20.4)		88 (5.1)	<0.001***	
Previous miscarriage/abortion	514 (26.7)		21 (18.9)		493 (27.1)	0.057	
Parity						0.122	
Primiparous	953 (49.6)		63 (56.8)		890 (49.2)		
Multiparous	967 (50.4)		48 (43.2)		919 (50.8)		
History of depression	292 (15.2)		34 (30.9)		258 (14.2)	<0.001***	
EPDS 12 weeks of pregnancy		4.36 ± 4.18		6.40 ± 5.17	4.23 ± 4.08		<0.001***
Above cut-off	108 (5.6)		16 (14.4)		92 (5.1)	<0.001***	
EPDS 22 weeks of pregnancy		5.08 ± 4.18		6.95 ± 5.01	4.97 ± 4.10		<0.001***
Above cut-off	115 (6.1)		17 (16.2)		98 (5.5)	<0.001***	
EPDS 32 weeks of pregnancy		4.98 ± 4.17		6.96 ± 5.16	4.86 ± 4.08		<0.001***
Above cut-off	104 (5.6)		15 (14.2)		89 (5.1)	<0.001***	

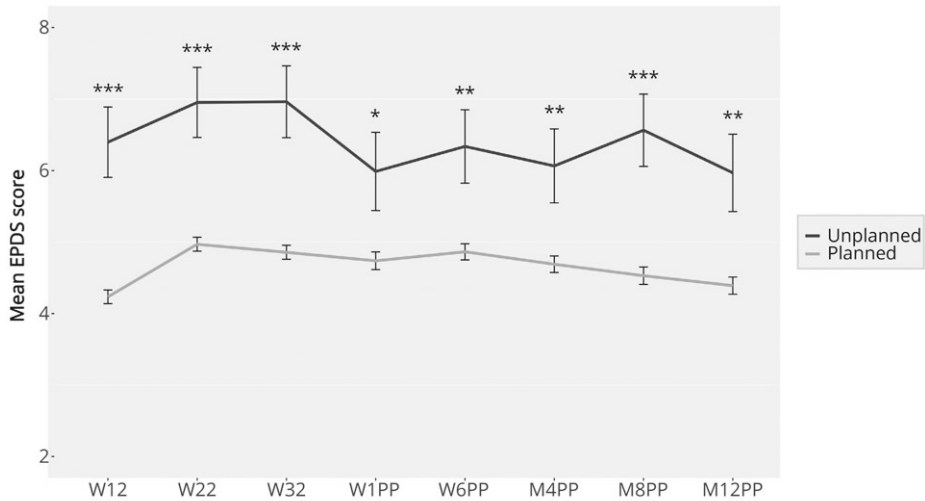
Table 1. Continued.

	Total N = 1928	Pregnancy intention				P-value
		Unplanned n = 111 (5.8%)		Planned n = 1817 (94.2%)		
	n (%)	Mean ± SD	n (%)	Mean ± SD	χ <sup>2</sup>	T-test
EPDS 1 week postpartum		4.80 ± 4.75		4.74 ± 4.74		0.023*
Above cut-off	122 (7.8)		8 (10.3)	114 (7.6)	0.399	
EPDS 6 weeks postpartum		4.94 ± 4.52		4.86 ± 4.50		0.004**
Above cut-off	123 (7.4)		12 (14.5)	111 (7.1)	0.012*	
EPDS 4 months postpartum		4.76 ± 4.55		4.69 ± 4.54		0.009**
Above cut-off	111 (6.9)		7 (9.0)	104 (6.8)	0.456	
EPDS 8 months postpartum		4.63 ± 4.63		4.53 ± 4.62		<0.001***
Above cut-off	112 (7.4)		10 (12.8)	102 (7.1)	0.060	
EPDS 12 months postpartum		4.47 ± 4.27		4.39 ± 4.25		0.004**
Above cut-off	73 (5.6)		7 (11.1)	66 (5.3)	0.052	

Note. BMI, Body Mass Index; EPDS, Edinburgh Postnatal Depression Scale; SD, Standard Deviation; Percentages are valid percentages; for the EPDS, a cut-off of ≥ 13 was used; \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001 †High: Bachelor or Master's degrees, low: primary education, secondary pre-vocational education, secondary education or vocational education

## Depressive symptoms

Mean EPDS scores, stratified for pregnancy intention, for all eight assessments during pregnancy and postpartum are shown in Table 1 (and visually in Figure 2). Women who reported an unplanned pregnancy showed significantly higher levels of depressive symptoms compared to women with a planned pregnancy at all time-points ( $t$ -values varying from -4.3 to -2.3,  $p$  varying from  $< 0.001$  to 0.023). Table 1 also shows the number of women scoring above the EPDS cut-off score for the presence of possible clinical depression. During the entire perinatal period (12 weeks of pregnancy up until 12 months postpartum), 460 (23.9%) women scored above the EPDS cut-off at least once. Of these 460 women 41 (36.9%) belonged to the group of 111 women with an unplanned pregnancy and 419 (23.1%) to the group of 1817 women with a planned pregnancy, which is statistically significant ( $\chi^2(1) = 11.1, p < 0.001$ ).



**Figure 2.** Depressive symptom mean scores at 12, 22 and 32 weeks of pregnancy and 1 week, 6 weeks, 4 months, 8 months and 12 months postpartum in women with a planned and an unplanned pregnancy.

*Note.* EPDS, Edinburgh Postnatal Depression Scale; W, weeks; M, months; PP, postpartum.

Error bars are standard error of the mean. T-tests: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$



### Linear mixed model analyses

In order to evaluate the course of depressive symptoms over time, discriminating between planned and unplanned pregnancy while adjusting for several covariates, we used linear mixed model analyses (Table 2). Women with an unplanned pregnancy had higher depressive symptom scores during the entire perinatal period compared to women with a planned pregnancy even after adjusting for various confounders ( $p < 0.001$ ). The confounders lower age ( $p = 0.006$ ), unemployment ( $p = 0.004$ ) and history of depression ( $p < 0.001$ ) were also significant predictors for perinatal depressive symptoms (Table 2). The unstandardized beta coefficient of unplanned pregnancy ( $B = -2.24$ ) can be explained as the percentage change in depressive symptom scores in women with an unplanned pregnancy, corresponding to 89.4% higher depressive symptom scores in women with an unplanned pregnancy compared to women with a planned pregnancy [formula:  $(\exp B - 1) * 100$ ]. The model showed a significant effect of time ( $p = 0.049$ ) and a significant quadratic effect of time (time\*time,  $p = 0.022$ ). Time showed a positive effect ( $B = 0.07$ ), which means that the overall level of depressive symptoms increases over time. The negative interaction ( $B = -0.02$ ) suggests that the steepness of this slope decreases over time, indicating that the increase of depressive symptom scores over time becomes less steep further into the postnatal period (a quadratic effect). However, the interaction terms unplanned pregnancy\*time ( $p = 0.167$ ) and unplanned pregnancy\*time\*time ( $p = 0.308$ ) were not significant. This indicates that, even though there was a significant difference in depressive symptom levels between women with a planned and an unplanned pregnancy, the *course* of depressive symptom scores over time was the same for both groups.

Because we observed a difference in the frequency of a history of depression between women with a planned pregnancy (14.2%) and women with an unplanned pregnancy (30.9%), we performed a sensitivity analysis repeating the mixed model analysis in a subgroup of women without a history of depression. This analysis showed similar results compared to that of the entire sample.

**Table 2.** Linear mixed models with unplanned pregnancy as a predictor for depressive symptoms during the perinatal period.

	Numerator df	Denominator df	F	P-value
Intercept	1	1992.671	58.114	< 0.001***
Unplanned pregnancy	1	5420.026	16.674	< 0.001***
Time	1	10637.198	3.863	0.049*
Unplanned pregnancy*Time	1	10637.518	1.912	0.167
Time*Time	1	10177.936	5.258	0.022*
Unplanned pregnancy*Time*Time	1	10178.167	1.038	0.308
Age	1	1811.030	7.635	0.006**
Level of education	1	1810.651	2.204	0.138
Paid job	1	1816.860	8.377	0.004**
Partner	1	1834.960	0.815	0.367
BMI pre-pregnancy	1	1805.323	2.577	0.109
Alcohol use during pregnancy	1	1823.576	0.643	0.423
Smoking during pregnancy	1	1835.531	2.860	0.091†
Previous miscarriage/abortion	1	1806.952	2.817	0.093†
Parity	1	1803.939	0.173	0.677
History of depression	1	1808.654	87.580	< 0.001***

Note. † $p < 0.10$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

## Discussion

In the current study, we aimed to examine the association between an unplanned pregnancy and depressive symptoms in a large longitudinal cohort, stretching from early pregnancy till 12 months postpartum. Women who reported an unplanned pregnancy showed persistently higher levels of depressive symptoms in all trimesters of pregnancy and during the first 12 months postpartum. Lower age, unemployment and a history of depression were independently related to higher levels of depressive symptoms reported during this period. We also showed that although women with an unplanned pregnancy showed persistently higher depressive symptom scores, the *course* of depressive symptom scores over time was similar to that of women with a planned pregnancy.

The association between unplanned pregnancy and depressive symptoms during the perinatal period has been reported in prior studies (e.g., Abajobir et al.<sup>20</sup>). However, almost all of these studies used a cross-sectional design or are limited by

two time points. For example, Mercier et al.<sup>36</sup> found that women with unintended pregnancies were more likely to have postpartum depression at both 3 and 12 months postpartum and Faisal-Cury et al.<sup>19</sup> found that unplanned pregnancy was associated with persistent maternal depression during the perinatal period. Our study adds a longitudinal aspect to the current literature, showing that higher levels of depressive symptoms persisted long after birth in women with unplanned pregnancy. In their longitudinal study, Christensen et al.<sup>21</sup> did not find an association between unintended pregnancy and high depressive symptom levels during pregnancy, however, unintended pregnancy was associated with high postpartum depressive symptom levels. Nevertheless, compared to our sample, their study included a smaller sample (215 women), participants were included in a randomized controlled trial, and they used the Beck Depression Inventory-II (BDI-II) to screen for depressive symptoms. Furthermore, where Christensen et al.<sup>21</sup> categorized pregnancy intention as intended, mistimed, and unwanted, the current study defined it as planned or unplanned pregnancy.

Another longitudinal study found that women with unwanted pregnancies, defined in terms of an unplanned *and* unwanted pregnancy and a negative first reaction to the pregnancy, reported slightly higher levels of perinatal depressive symptom scores, however, it diminished over the follow-up period<sup>22</sup>. It may be difficult to compare the results of this study with the results of the current study. First, a different instrument, the Delusions-Symptoms-States Inventory (DSSI) was used to measure depressive symptoms. Secondly, the data of this study were collected between 1981 and 1984, almost 40 years ago. At that time, there might have been a different view on having an unplanned pregnancy and experiencing mental problems, which could have influenced the results of this study.

In the current study, 5.8% of the women reported an unplanned pregnancy, which corresponds to the national rates of the Netherlands in 2016, when 3% of the pregnancies were unplanned (similar for all levels of education)<sup>37</sup>. These numbers are significantly lower than the number of unintended pregnancies found in studies from other countries, such as in the United States (45% unintended)<sup>38</sup> and the United Kingdom (16.2% unplanned, 29.0% ambivalent)<sup>39</sup>. Apart from the differences between the obstetric health care systems in different countries, another possible explanation for this difference could be the cultural differences in sexual education

and contraception use. In many regions of the United States, the dominant sex education model focuses on abstinence-based ways to avoid pregnancy, whereas in the Netherlands there are comprehensive and liberal school-based sex education programs. It has been shown that the sexual health-related outcomes (e.g., unwanted pregnancy rates and sexually transmissible infection statistics) are better in countries with sex positive government policies (such as the Netherlands) in comparison to countries with a policy-based on abstinence, such as the United States<sup>40</sup>. These cultural differences may therefore explain the low percentage of women reporting an unplanned pregnancy in the current study.

### **Strengths and limitations**

The major strengths of the current study are the large sample size (N = 1928) and the prospective longitudinal design assessing depressive symptoms at each trimester of pregnancy and five times postpartum enabling the use of mixed linear models. Other studies that assessed the relationship between an unplanned pregnancy and perinatal depressive symptoms mostly used a cross-sectional design or assessed depressive symptoms only twice during pregnancy or during the postpartum period. While these studies provide important information on the association between an unplanned pregnancy and depressive symptoms<sup>20</sup>, the current study clearly demonstrates that an unplanned pregnancy seems to be a risk factor for heightened depressive symptom levels throughout the entire perinatal period until 12 months after giving birth.

This study also has limitations. The first limitation of this study is the assessment of an unplanned pregnancy. This study measured pregnancy intention by asking the question: “is the current pregnancy planned?” Women could indicate whether their current pregnancy was planned by selecting “yes” or “no”. In the Netherlands, most women who ask for an abortion provocatus because of an unwanted pregnancy visit a special abortion clinic before 8-10 weeks of gestation. Because in the current study community midwives included all participating women between 8-12 weeks, it is likely that most women with an unplanned and unwanted pregnancy have already made the decision for abortion. As a result, these women were not included in the study. Taken this background information into account, it is even more remarkable that an unplanned pregnancy – even when it is only unplanned but not unwanted – has a long-lasting negative impact on a woman’s perinatal mental health. Nonetheless,

there is still much inconsistency in the literature about these terms and the exact definition of an unplanned pregnancy. The terms unplanned, unintended, mistimed and unwanted pregnancy are often used interchangeably in the literature, yet there are important differences between these concepts<sup>14,15</sup>. Further studies are needed to address these differences in terminology. Barrett et al.<sup>41</sup> developed the London Measure of Unplanned Pregnancy and Goossens et al.<sup>42</sup> evaluated the psychometric properties of the Flemish version of this measurement. This measurement takes the complexity of pregnancy planning into account (example concepts: contraception use and pregnancy intention before becoming pregnant). It could be used in future studies, but it is also important to address the emotions that are associated with an unplanned pregnancy. A cross-sectional study by Barton et al.<sup>43</sup> showed that women with an unplanned pregnancy who had negative or ambivalent feelings towards their pregnancy, showed higher levels of psychological distress compared to women with an unplanned pregnancy that had happy feelings towards being pregnant.

Another limitation of the present study is that we assessed depressive symptoms by self-report instead of a diagnostic interview such as the SCID<sup>44</sup>. Similarly, history of depression was measured with a self-reported yes/no response. A more objective assessment of life-time history of depression would have given a better understanding of the concept, using a structural and standardized psychiatric diagnostic interview (e.g., CIDI, SCID). These instruments assessing the life-time history of depression are the golden standard allowing to discriminate between a major depressive episode and minor depression. Interview procedures are challenging in a longitudinal study like the current study with a large sample size (N = 1928). Furthermore, the DSM-5 highly advises that depressive symptoms are assessed regarding their intensity rather than using a dichotomous definition of depression only<sup>45</sup>.

Moreover, the participants of this study were more often highly educated, and most of them had a partner. Also fewer participants had an ethnic minority background compared to the general Dutch population<sup>46,47</sup>. These factors may have had an attenuating effect on the level of depressive symptoms as related to unplanned pregnancy and it is therefore difficult to generalize the present findings to other settings and countries. Additionally, social support was not considered in the present study, which is an important factor in the association of potentially negative experiences with perinatal depression (e.g., Biaggi et al.<sup>10</sup>). A final limitation of the

study is that there is no data available on the use of antidepressants, psychotherapy, or psychological counseling for the participating women throughout the entire perinatal study period. Treatment for depression during the perinatal period may have reduced the level of depressive symptoms.

### **Possible clinical implications**

Our findings show strong support for the view that women with an unplanned pregnancy represent a group vulnerable to developing mental health problems. An important clinical implication could be that these women should be carefully followed, not only during pregnancy but also during the first postpartum year (and potentially beyond). Proactive screening of depressive symptoms followed by an intervention has repeatedly shown to be beneficial<sup>48</sup>. Furthermore, perinatal depressive symptoms can lead to negative maternal mental health outcomes, such as increased level of parental stress<sup>49</sup>, greater difficulties with social and partner relationships<sup>50</sup> and suboptimal mother-to-infant bonding<sup>51</sup>. The EPDS is a short and widely applicable instrument to screen for perinatal depression<sup>48</sup>, which could easily be administered by midwives and obstetricians during pregnancy and by the general practitioners and infant health care workers during the first postpartum year.

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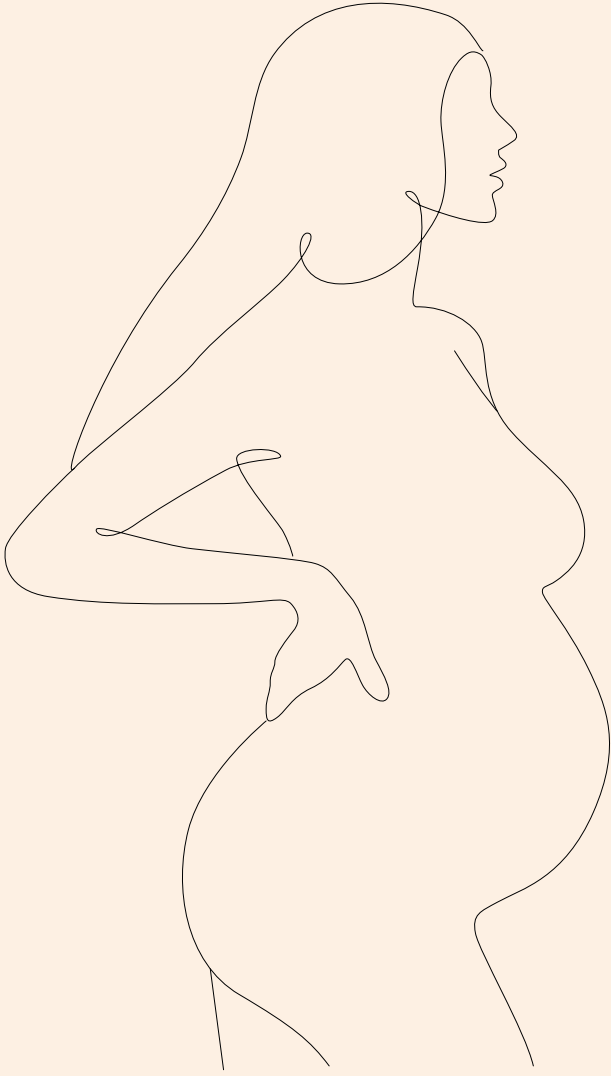
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# Chapter 3

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

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## 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.

## 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%<sup>1-4</sup>. 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<sup>5</sup>. One suggestion for this paradox could be the growing extensive social media use (SMU) by young adults, including pregnant women<sup>5,6</sup>.

Accumulating research has shown an association between excessive SMU and depressive symptoms in both adolescent and adult populations<sup>7-12</sup>. SMU is described as *intense* when individuals use social media “very often”<sup>13</sup>, characterized by more than 7 hours a day<sup>12,14,15</sup>. 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<sup>14</sup>. 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<sup>10,16,17</sup>. In line with this, another study found that intense social media users generally spend less offline time with their friends or family<sup>12</sup>. However, this association can also be the other way around, for example, loneliness, an important predictor of depression, could be an important driver of frequent internet use<sup>18</sup>.

Recently, Smith et al.<sup>19</sup> 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<sup>20</sup>. 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)<sup>19,21</sup>, especially when it concerns their first pregnancy.

Because depressive symptoms can vary substantially over time, it is especially important to assess depressive symptoms longitudinally<sup>22</sup>. A method which takes into account the symptom variability over time both between and within individuals is growth mixture modeling<sup>23</sup>. 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<sup>7-12</sup> it was hypothesized that women with more intense and problematic SMU would show heightened depressive symptom levels during pregnancy.

## Methods

### 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.<sup>24</sup>). 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 ( $\chi^2(1) = 4.67, p = 0.031$ , 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.

## Measures

### ***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)<sup>25,26</sup>. This questionnaire has been validated among Dutch pregnant women for use during pregnancy<sup>27</sup>. 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<sup>27</sup>. The EDS is a valid and reliable instrument to assess depressive symptoms<sup>26-28</sup>. In the current study, the Cronbach's alphas were 0.84, 0.83 and 0.85 per trimester, respectively.

### ***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.".

#### ***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 hours. For example, *I don't use social media* was recoded to 0 hours, *less than half an hour a day* to 0.5, *3 hours a day* to 3 hours and *7 or more hours a day* was recoded to 7 hours. 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 hour a day* and 4 = *2 hours 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*<sup>8,10</sup>, which were converted into mean social media visits per week that ranged between 0 and 35 times<sup>8,10</sup>. 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.

### ***Problematic social media use***

Problematic SMU was assessed with the six-item Bergen Social Media Addiction Scale (BSMAS) at 12 weeks of pregnancy<sup>29</sup>. The BSMAS is an adaptation of the validated Bergen Facebook Addiction Scale<sup>30</sup> to assess problematic use of social media in general<sup>29</sup>. Each item represents one of six core elements of addiction, namely salience, mood modification, tolerance, withdrawal, conflict, and relapse<sup>31</sup>. 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*<sup>30</sup>.

### ***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).

### **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<sup>32</sup>. 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)<sup>33,34</sup>, as well as the entropy<sup>35</sup>, 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.

## Results

### 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 hours a day, and 19.5 times a week on social media and had a mean BSMAS score of 9.6 (SD = 3.3).

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

	No. (%)	Mean (SD)	Range
<i>Demographics</i>			
Age (years)		31.0 (3.6)	19 – 42
High level of education <sup>a</sup>	492 (70.6)		
Employment	669 (96.0)		
Having a partner	687 (98.6)		
<i>Pregnancy-related</i>			
Multiparity	329 (47.2)		
Unplanned pregnancy	50 (7.2)		
Previous miscarriage / abortion	195 (28.0)		
Obstetric complication <sup>b</sup>	122 (17.5)		
<i>Psychological features</i>			
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
<i>Social media</i>			
SMU Time <sup>c</sup> at 12 weeks	697 (100.0)	1.6 (1.1)	0 – 7
SMU Frequency <sup>d</sup> 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

*Note.* SD, standard deviation; EDS, Edinburgh Depression Scale; SMU, Social Media Use.

<sup>a</sup> Bachelor's degree or higher

<sup>b</sup> Including intrauterine growth restriction, pre-eclampsia, and diabetes gravidarum

<sup>c</sup> Assessed in hours per day

<sup>d</sup> Measuring site visits per week

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

$p < 0.001$ ). 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  $p < 0.001$ ).

**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***

Note. BSMAS, Bergen Social Media Addiction Scale; SMU, Social Media Use;

EDS, Edinburgh Depression Scale

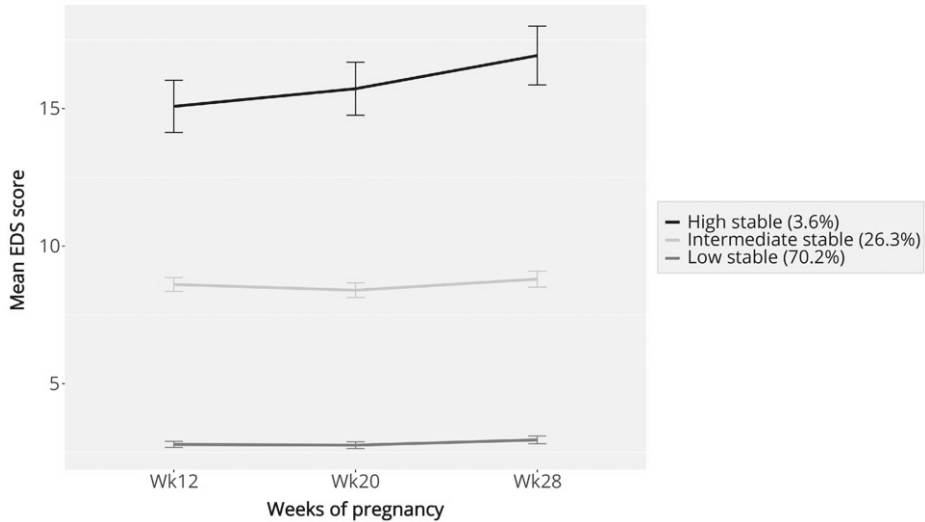
\*\*\* $p < 0.001$

### 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 Tables 1 and 2 in the Supplement).

Figure 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 - 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 - 8.8). 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 - 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:  $F(2, 420 \text{ to } 694) = 337.6 \text{ to } 461.2$ , all  $p < 0.001$ ,  $\eta^2 = 0.57 \text{ to } 0.62$  (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  $p < 0.001$ ).



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

Note. EDS, Edinburgh Depression Scale; Wk, Week

### 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 hours a day and 19.0, 20.2 and 23.9 times a week on social media, respectively. Furthermore, the 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.

#### Intensity of social media use

For SMU time, the unadjusted estimates were OR = 1.16, 95% CI [0.99, 1.35],  $p = 0.062$  for the intermediate stable depression class and OR = 1.42, 95% CI [1.03, 1.94],  $p = 0.030$  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],  $p = 0.017$ ) 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],  $p = 0.219$  and OR = 1.04, 95% CI [1.002, 1.08],  $p = 0.038$  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],  $p = 0.019$ ) compared to the odds of belonging to the low stable class.

#### ***Problematic social media use***

The unadjusted estimates were OR = 1.17, 95% CI [1.11, 1.23],  $p < 0.001$  per scale unit for the intermediate stable class and OR = 1.33, 95% CI [1.19, 1.47],  $p < 0.001$  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],  $p < 0.001$ ) and the high stable class (OR = 1.31, 95% CI [1.17, 1.46],  $p < 0.001$ ), using the low stable class as reference.

**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 <sup>a</sup>	1.16	[0.98, 1.37]	0.093	1.51	[1.08, 2.12]	<b>0.017</b>
SMU Frequency <sup>b</sup>	1.01	[0.99, 1.03]	0.231	1.05	[1.01, 1.09]	<b>0.019</b>
Problematic SMU (BSMAS) <sup>c</sup>	1.17	[1.11, 1.23]	<b>&lt; 0.001</b>	1.31	[1.17, 1.46]	<b>&lt; 0.001</b>

*Note.* 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.*

<sup>a</sup> Model 1, SMU Time (assessed in hours per day) as independent variable

<sup>b</sup> Model 2, SMU Frequency (site visits per week) as independent variable

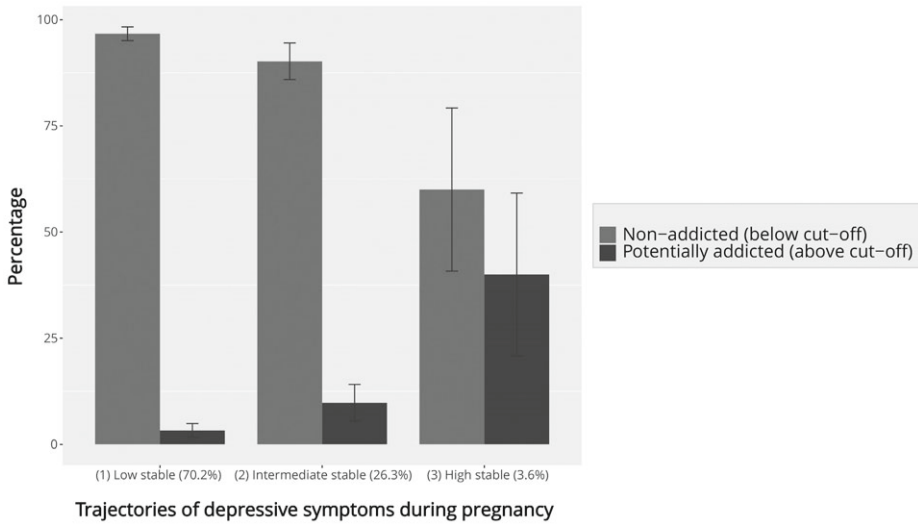
<sup>c</sup> Model 3, Problematic SMU (assessed using the BSMAS) as independent variable

**Bold:** significance as defined by  $p < 0.05$ .

### **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 ( $\chi^2(2) = 59.5, p < 0.001$ ). Figure 2 shows the distribution of BSMAS cut-off scores stratified according to the trajectories of depressive symptoms during pregnancy.





**Figure 2.** Distribution of BSMAS cut-off scores stratified according to trajectories of depressive symptoms during pregnancy.

*Note.* Cut-off +: scoring 3 or above on at least four of the six BSMAS items; BSMAS, Bergen Social Media Addiction Scale

## 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. These studies also found that problematic SMU was associated with more mental health problems

in adolescents<sup>11,12</sup> and adults<sup>10</sup>. However, the majority of previous studies found no or weak associations with intensity of SMU<sup>10-12</sup>. 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<sup>36</sup>, 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<sup>36</sup>. 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<sup>37</sup>. 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<sup>19,38</sup>. 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<sup>39</sup>. 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<sup>10-12</sup>. 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<sup>40</sup>. Moreover, the COVID-19 pandemic showed to have a negative impact on depressive symptoms in pregnant women<sup>41-43</sup>. 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<sup>44</sup>. Another limitation is that SMU was measured by self-report and thus, relied on the estimates of participants, which may have caused retrospective bias<sup>45</sup>. Future research on SMU should use more direct methods to register SMU for more objective results, such as experience sampling methods<sup>45</sup>.

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., midwives during regular appointments), in addition to the known risk factors which have been previously and consistently reported in research (see Biaggi et al.<sup>46</sup> 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<sup>47,48</sup>. Furthermore, depressive symptoms during pregnancy have been associated with parental stress up to six months postpartum and suboptimal mother-to-infant bonding<sup>49,50</sup>. Still, more research is necessary to determine the causal relationship between SMU and depressive symptoms before clear clinical implications and guidelines can be drafted.

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## Supplement Chapter 3

**Table 1.** Growth mixture modeling of different trajectories of depressive symptoms during pregnancy: fit indices (N = 697).

Number of classes	BIC	LMR-LRT <i>P</i>	BLRT <i>P</i>	Entropy	Percentage of women per class
1	9139.84	-	-	1.0	100
2	9068.61	0.163	< 0.001	0.82	90.4; 9.6
<b>3</b>	<b>9034.02</b>	<b>0.099</b>	<b>&lt; 0.001</b>	<b>0.78</b>	<b>70.2; 26.3; 3.6</b>
4	8994.18	0.152	< 0.001	0.76	72.4; 12.8; 11.6; 3.2
5	8983.83	0.048	< 0.001	0.79	66.6; 16.0; 13.4; 3.4; 0.6

*Note.* BIC, Bayesian Information Criterion; LMR-LRT, Lo-Mendell-Rubin Likelihood Ratio Test; BLRT, Bootstrapped Likelihood Ratio Test. Models with a better fit were indicated by lower BIC values<sup>1</sup>. A significant LMR-LRT and BLRT indicate that the model fit is improved in a model with an extra class. When identifying the ideal number of classes, the BLRT is superior to the LMR-LRT<sup>2</sup>. Moreover, the entropy was accounted for, where values closer to 1 indicate a better delineation of classes<sup>1</sup>. The parsimony and interpretability of the models were also considered. Values in **bold** indicate the final model.



**Table 2.** Parameter estimates and average posterior probabilities for the three longitudinal trajectories (classes) of depressive symptoms during pregnancy (N = 697).

Trajectory of depressive symptoms	No. (%)	APP	Parameters	Estimate (SE)
1. Low stable	489 (70.2)	0.93	<i>Mean</i>	
			Intercept	2.79 (0.31)***
			Slope	0.06 (0.12)
			<i>Variances</i>	
			Intercept	1.09 (0.64) <sup>†</sup>
			Slope	Fixed to zero
			<i>Residual variances</i>	
			12 weeks	7.32 (0.51)***
			20 weeks	7.32 (0.51)***
			28 weeks	7.32 (0.51)***
2. Intermediate stable	183 (26.3)	0.83	<i>Mean</i>	
			Intercept	7.87 (1.07)***
			Slope	0.20 (0.38)
			<i>Variances</i>	
			Intercept	1.09 (0.64) <sup>†</sup>
			Slope	Fixed to zero
			<i>Residual variances</i>	
			12 weeks	7.32 (0.51)***
			20 weeks	7.32 (0.51)***
			28 weeks	7.32 (0.51)***
3. High stable	25 (3.6)	0.85	<i>Mean</i>	
			Intercept	12.91 (2.48)***
			Slope	1.49 (1.79)
			<i>Variances</i>	
			Intercept	1.09 (0.64) <sup>†</sup>
			Slope	Fixed to zero
			<i>Residual variances</i>	
			12 weeks	7.32 (0.51)***
			20 weeks	7.32 (0.51)***
			28 weeks	7.32 (0.51)***

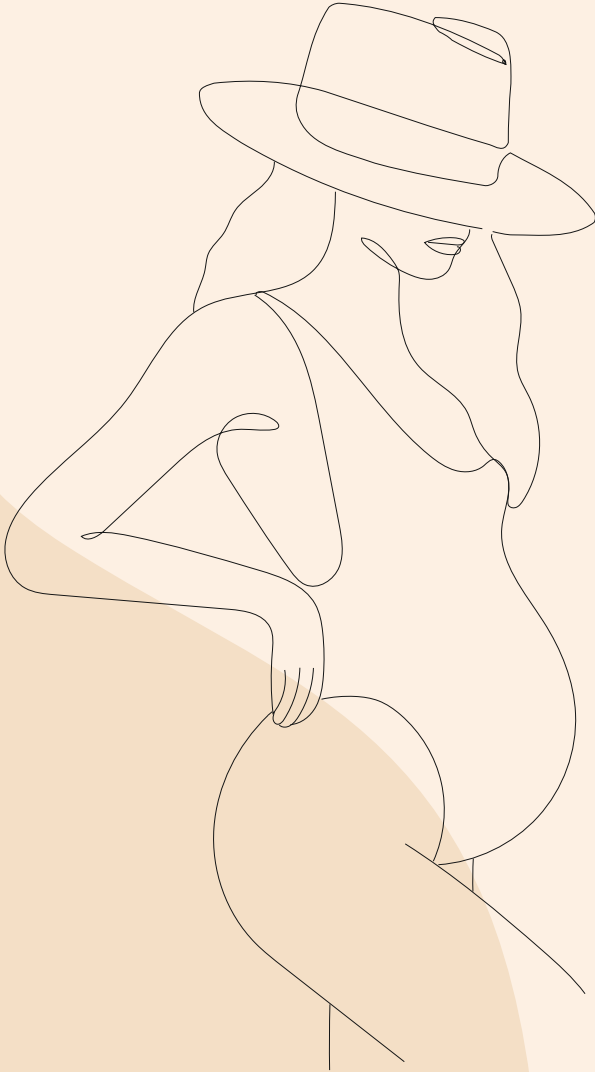
Note. APP, average posterior probability; SE, standard error. For the intercept growth factor, the variance was estimated but held equal across classes. For the linear slope growth factor, the variance was fixed at zero in each class. The residual variance was held equal across classes and over time.

<sup>†</sup> $p < 0.10$ , \*\*\* $p < 0.001$

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# Chapter 4

## **Browsing throughout pregnancy: the longitudinal course of social media use during pregnancy**

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Midwifery 2024; 129; 103905

## Abstract

**Background:** The number of people using social media has substantially increased over the past years. Previous studies have shown associations between social media overuse and mental health problems during pregnancy. The current study evaluates changes in social media use during pregnancy.

**Methods:** Pregnant women were recruited at their first antenatal appointment between January 2020 and July 2022 (N = 1135). The time spent on social media, frequency of social media use and problematic social media use, using the Bergen Social Media Addiction Scale (BSMAS), were assessed at 12, 20 and 28 weeks of pregnancy. Pearson *r* correlations and repeated measures ANOVAs were performed to assess possible changes in social media use over the course of pregnancy. Lastly, we stratified social media use throughout pregnancy for parity.

**Results:** There was a significant change in social media use over time, for the time spent on social media, frequency of social media use and problematic social media use. Mean social media scores were the lowest at 12 weeks of pregnancy and increased significantly at 20 weeks of pregnancy, after which they remained stable at 28 weeks. Compared to multiparous women, primiparous women spent more time on social media at 20 weeks of pregnancy, but not at 12 or 28 weeks.

**Conclusion:** Because overuse of social media has been associated with poor mental health, healthcare professionals should be aware of the intensity of social media use throughout pregnancy.

## Introduction

Over the past years, the percentage of people using social media has increased. In 2012, 61.5% of individuals aged 12 years and older used social media in the Netherlands<sup>1</sup>. In 2019, this rate was 87.4%<sup>2</sup> and even 96% for people between the ages of 25 and 45 years<sup>2</sup>. Given these high percentages, it is important to understand the potential risk of excessive or even problematic social media use, as this could eventually lead to social media addiction. Problematic social media use refers to being less able to regulate social media use impulses, feeling discomfort when not able to use social media and thinking of the use of social media constantly<sup>3</sup>. Previous studies have shown associations between excessive social media use and depressive symptoms in non-pregnant populations<sup>4-9</sup>.

Pregnancy is a period in which many emotional, social, and physiological changes take place<sup>10,11</sup>. Pregnant women may therefore be especially vulnerable to problematic social media use and its negative consequences for mental health, such as more symptoms of depression, anxiety, and stress. Additionally, many social media platforms and influencers are specifically targeting pregnant women, for example through sharing pregnancy- and child-related products and advice<sup>12</sup>. Pregnant women and mothers also target other (expectant) mothers with pregnancy-related posts, for example by sharing information and emotional support<sup>13</sup>. Previous studies have indeed demonstrated associations between social media use during pregnancy and more negative affect, self-criticism, lower quality of life, and even higher levels of depressive symptoms<sup>14,15</sup>. A possible explanation for these associations is that pregnant women might have specific motivations to use social media. According to earlier research, the main reasons for women to use social media during the perinatal period are the need of social support, emotional support and information<sup>15-18</sup>. However, when seeking support online, women can be confronted with misinformation<sup>12</sup>, judgment<sup>19</sup>, and unrealistic representations<sup>20</sup>.

Because problematic social media use may have negative consequences for the mental health of pregnant women, such as more symptoms of depression, anxiety and stress<sup>14,15</sup>, it is important to assess the use of social media over the course of pregnancy. During the three trimesters of pregnancy, women may have different motivations to use social media. For example, because of a higher risk of miscarriage,

many women do not yet disclose their pregnancy in the first trimester<sup>21</sup>. These women often search online for support and information to answer their questions<sup>21,22</sup>, possibly resulting in increased use. In the third trimester, there may be different reasons pregnant women (over)use social media. Due to reduced mobility and changes in social and work-related activities, for instance, women may have reduced live social contacts, which could make them feel lonely. These women might use social media to compensate for not having many live contacts<sup>23</sup>. Taken together, problematic use of social media might not be stable during pregnancy, with variations from the first to the third trimester.

Furthermore, there might also be a difference in social media use during pregnancy for primiparous and multiparous women. Previous studies found that primiparous women experience more pregnancy-related worries and anxiety than multiparous women<sup>24-26</sup>. As a consequence, primiparous women might search online for support and information more often than multiparous women who have already experienced a normal evolving pregnancy.

Optimal physical and mental health of pregnant women is of the utmost importance for both the mother and the fetus<sup>27</sup>. Since social media use may increase pregnant women's mental health issues, including more symptoms of depression, anxiety and stress, increase self-criticism, and lower their quality of life<sup>14,15</sup>, it is important to understand during which trimesters pregnant women are most vulnerable to possible negative influences of social media and potentially problematic social media use. This might also be helpful for health care professionals, to know what the most optimal timing and frequency is in asking about social media use during pregnancy.

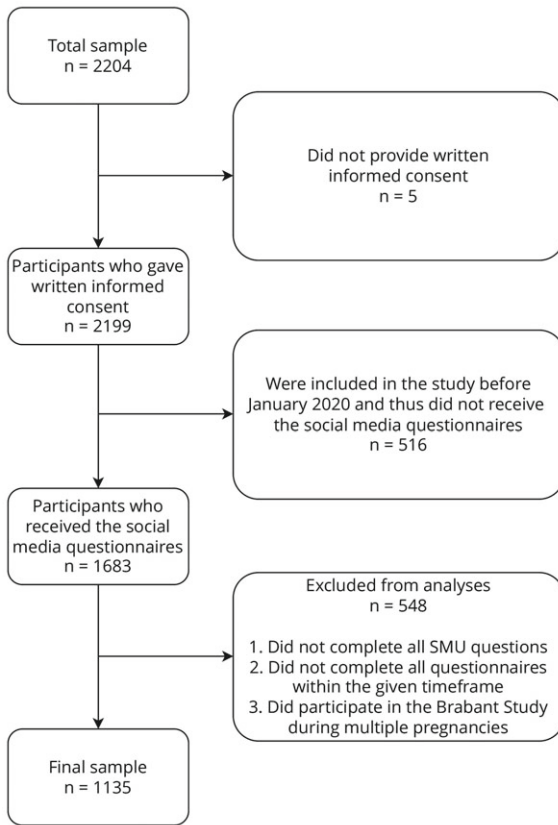
The primary aim of this study is to assess the possible variability of intensity and problematic social media use over the course of pregnancy from the first to the third trimester. The secondary aim was to assess whether primiparous and multiparous women differed in their social media use over the course of pregnancy. Based on existing literature, we expect to find a U-shaped pattern of social media use during pregnancy, with an increase of social media use in the first and third trimesters. Furthermore, we expect to find higher social media scores during pregnancy in primiparous women in comparison to multiparous women.



## Materials and methods

### Participants and procedure

Participants were recruited as part of a large longitudinal prospective cohort study in the Netherlands, the Brabant Study, of which details have been described elsewhere<sup>28</sup>. Dutch-speaking women (18+ years old) were recruited by community midwives or obstetricians during their first antenatal appointment. Women with high-risk pregnancies were excluded from participation in the Brabant Study, to ensure that the study outcomes were not affected by pregnancies that are often characterized by (highly) invasive interventions, such as primary cesarean sections. Exclusion criteria were a 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. At 12, 20 and 28 weeks of pregnancy, participants of the Brabant Study filled out questionnaires. Between May 2018 and July 2022, 2204 women agreed to participate in the study; however, five women did not provide written informed consent (N = 2199) and were subsequently excluded. Further, 516 women were included prior to January 2020, and subsequently did not receive the social media questionnaires, which were not administered prior to January 2020. Of the 1683 women that did receive the social media questionnaires, 1150 (68.3%) women completed all social media use questions at 12, 20 and 28 weeks of pregnancy within a timeframe of four weeks (12 +/- 4 weeks, 20 +/- 4 weeks and 28 +/- 4 weeks). Furthermore, fifteen women participated during multiple pregnancies in the Brabant Study, for which all responses except their first complete participation were excluded from this study. This resulted in a total sample of 1135 women in the current study. See Figure 1 for the flowchart.



**Figure 1.** Flowchart for the participating women in the current study (N = 1135)

*Note.* SMU, Social Media Use

The included sample (N = 1135) was compared to the excluded sample (N = 460) regarding demographic and obstetric variables. Only differences in educational level and employment were found between the women who completed all social media questionnaires and the women who did not. Women in the included sample were more often highly educated ( $\chi^2(1) = 3.97, p = 0.046$ , phi coefficient = 0.05, small effect size) and more often had a paid job ( $\chi^2(1) = 5.11, p = 0.024$ , phi coefficient = 0.06, small effect size).

The study was approved by the Medical Ethics Committee at the Máxima Medical Centre Veldhoven (NL64091.015.17).

## Measures

### **Social media use**

Both *intensity* of social media use and *problematic* social media use were measured at 12, 20 and 28 weeks of pregnancy. Social media were defined as: “Facebook, Instagram, LinkedIn, Pinterest, Twitter, YouTube, etc.”.

#### ***Intensity of social media use***

Both the time spent on social media (SMU Time) and the frequency of social media use (SMU Frequency) were measured. To measure SMU Time participants were asked how many hours per day they used social media (“*How many hours a day do you use social media platforms?*”). Participants could choose between nine options ranging from 1 = *I don’t use social media* to 9 = *seven or more hours a day*. The scores were converted into actual hours that ranged between 0 and 7 hours a day. More specifically, *I don’t use social media* was recoded to 0 hours, *less than half an hour a day* to 0.5 hours, *3 hours a day* to 3 hours, and *7 or more hours a day* was recoded to 7 hours.

To measure SMU frequency, participants were asked how frequently they visited social media platforms (“*How frequently do you visit social media platforms?*”). Participants could select one of the seven options, ranging between 1 = *I don’t use social media* and 7 = *five or more times a day*. These scores were converted into mean social media visits per week that ranged between 0 and 35 visits<sup>8,9</sup>. For example, *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.

#### ***Problematic social media use***

The Bergen Social Media Addiction Scale (BSMAS) was used to assess problematic social media use during pregnancy<sup>29</sup>. This questionnaire is adapted from the validated Bergen Facebook Addiction Scale<sup>30</sup>. Each item represents one of six core elements of addiction: salience, mood modification, tolerance, withdrawal, conflict, and relapse<sup>31</sup>. For example, women were asked to what extent they tried to cut down on the use of social media without success. Participants were asked to rate six items on a five-point Likert Scale (1 = *very rarely* to 5 = *very often*). Total scores range from 6 to 30 and higher scores indicate more problematic social media use. In the current study, the Cronbach’s alpha of the BSMAS ranged between 0.76 and 0.79. Furthermore,

in this study a cut-off score of 3 or above on at least four of the six items, indicates *potential social media addiction*<sup>30</sup>.

### ***Descriptive characteristics***

At 12 weeks of pregnancy demographic, obstetric and psychological features were assessed such as *age, level of education, employment, having a partner, parity, unplanned pregnancy, previous miscarriage or abortion and depression earlier in life* using self-report.

### **Statistical analyses**

To assess whether the three social media variables were stable over time, the rank-order stability of the variables was checked by performing Pearson *r* correlations between all three time points for each social media variable separately. Furthermore, to assess possible change in social media use scores over time (12, 20 and 28 weeks of pregnancy), three repeated measures ANOVAs were performed to evaluate the mean-level stability for the three social media variables. Using three mixed between-within-subjects ANOVAs, the possible change of social media use over time (SMU Time, SMU Frequency and BSMAS) in both primiparous and multiparous women were assessed. Lastly, independent sample t-tests were used to show possible differences in mean social media use scores between the primiparous and multiparous women. Analyses were performed in SPSS (version 27.0).

## **Results**

Table 1 shows the participant characteristics and mean variable scores. Women in the current study had a mean age of 31.3 (SD = 3.6). Most women were employed (97.1%) and had a partner (98.5%). Almost half of the women were multiparous (47.2%). Figure 2 (a, b, and c) shows the mean social media scores for SMU Time, SMU Frequency and the BSMAS, respectively. Throughout pregnancy, women spent between 1.6 and 1.8 hours a day on social media and reported to visit social media platforms between 19.8 and 20.6 times per week. The mean BSMAS scores were 9.40, 9.76 and 9.84 at 12, 20 and 28 weeks, respectively. Of the 1135 women, 119 (10.5%) scored above the cut-off of the BSMAS at least once. At 12, 20 and 28 weeks of pregnancy, 59 (5.2%), 80 (7.0%) and 65 (5.7%) of women scored above the BSMAS cut-off, respectively.

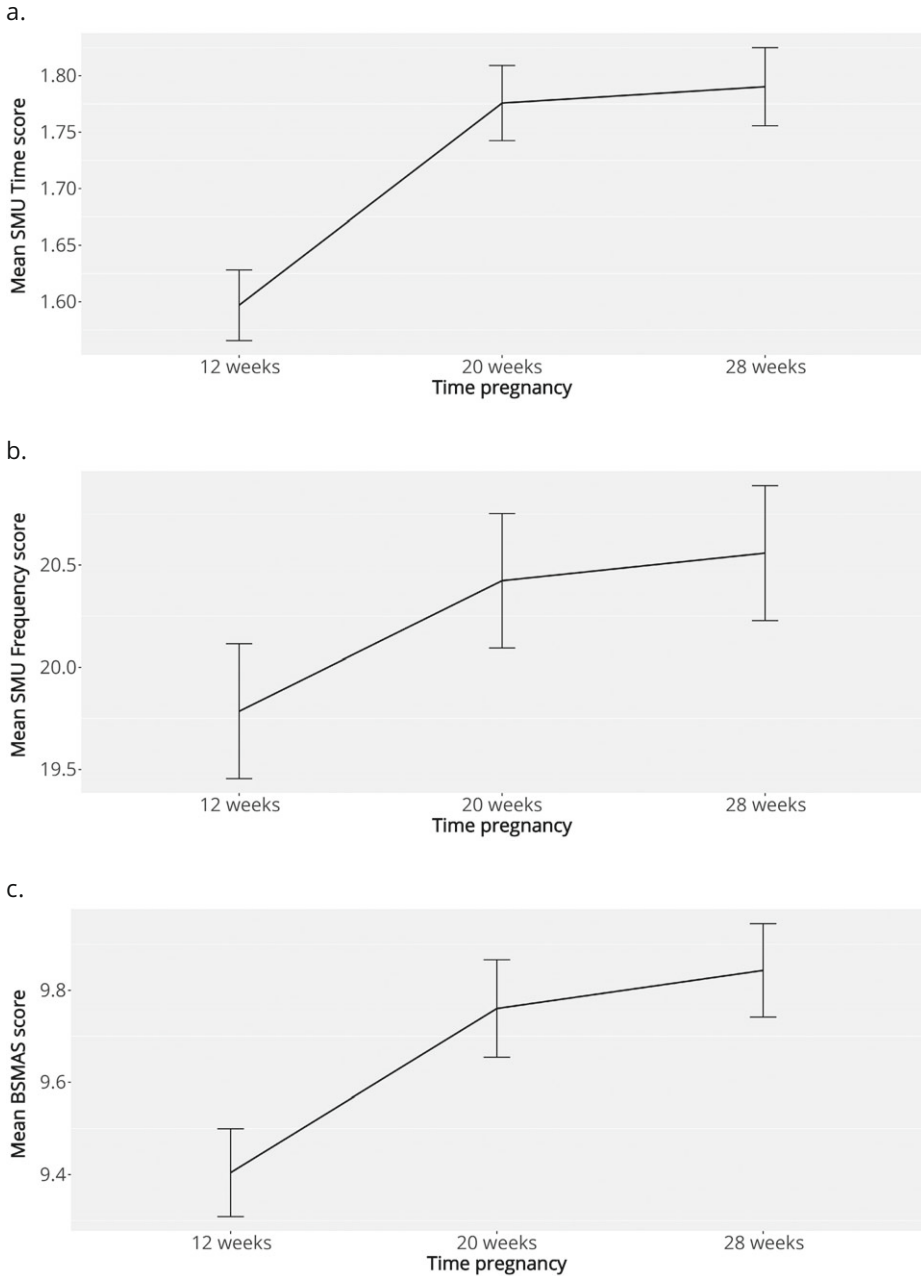
Demographic and obstetric variables were compared between women who scored above the BSMAS cut-off and the group of women who did not. Women who scored above the cut-off, less often had a paid job ( $\chi^2(1) = 6.86, p = 0.009$ , phi coefficient =  $-0.08$ , small effect size) and more often had a history of depression ( $\chi^2(1) = 15.12, p < 0.001$ , phi coefficient =  $0.12$ , small effect size). The two groups did not differ regarding age, level of education, having a partner, parity, unplanned pregnancy and previous miscarriage or abortion.

**Table 1.** Characteristics of the participating women (N = 1135).

	No. (%)	Mean (SD)	Range
<i>Demographics</i>			
Age (years)		31.33 (3.58)	19 – 43
High level of education <sup>a</sup>	838 (73.8)		
Employment	1102 (97.1)		
Having a partner	1118 (98.5)		
History of depression	134 (11.8)		
<i>Pregnancy-related</i>			
Multiparity	536 (47.2)		
Unplanned pregnancy	76 (6.7)		
Previous miscarriage / abortion	324 (28.5)		
<i>Social media use</i>			
SMU Time <sup>b</sup>			
12 weeks		1.60 (1.05)	0 – 7
20 weeks		1.78 (1.12)	0 – 7
28 weeks		1.80 (1.17)	0 – 7
SMU Frequency <sup>c</sup>			
12 weeks		19.79 (11.1)	0 – 35
20 weeks		20.42 (11.1)	0 – 35
28 weeks		20.56 (11.1)	0 – 35
BSMAS			
12 weeks		9.40 (3.22)	6 – 24
20 weeks		9.76 (3.57)	6 – 30
28 weeks		9.84 (3.42)	6 – 26
Cut-off BSMAS			
Above cut-off BSMAS $\geq 1$ <sup>d</sup>			
12 weeks	119 (10.5)		
20 weeks	59 (5.2)		
28 weeks	80 (7.0)		
28 weeks	65 (5.7)		

*Note.* SD, standard deviation; SMU, Social Media Use

<sup>a</sup> Bachelor's degree or higher; <sup>b</sup> Assessed in hours per day; <sup>c</sup> Measuring site visits per week; <sup>d</sup> Women who scored above the BSMAS cut-off at least once during their pregnancy



**Figure 2.** Mean social media use scores at 12, 20 and 28 weeks of pregnancy for SMU Time (panel a), SMU Frequency (panel b) and the BSMAS (panel c)

*Note.* SMU, Social Media Use; BSMAS, Bergen Social Media Addiction Scale. Error bars are standard error of the mean

### Stability of social media use during pregnancy

The data on the three timepoints, 12, 20 and 28 weeks of pregnancy, were significantly correlated within each social media variable, which means the social media variables were stable over time, all  $p < 0.001$  (see Table 2).

**Table 2.** Pearson correlations between the different timepoints (12, 20 and 28 weeks of pregnancy) for the three social media variables.

	1.	2.	3.
1. SMU Time 12			
2. SMU Time 20	0.715***		
3. SMU Time 28	0.712***	0.757***	
	4.	5.	6.
4. SMU Frequency 12			
5. SMU Frequency 20	0.700***		
6. SMU Frequency 28	0.701***	0.721***	
	7.	8.	9.
7. BSMAS 12			
8. BSMAS 20	0.717***		
9. BSMAS 28	0.674***	0.726***	

*Note.* BSMAS, Bergen Social Media Addiction Scale; SMU, Social Media Use; \*\*\* $p < 0.001$

Next, repeated measures ANOVAs were used to assess the possible change in social media use scores from 12 to 28 weeks of pregnancy. A significant change in SMU Time was demonstrated across the three different time points, Wilks' Lambda = 0.94,  $F(2, 1133) = 36.39$ ,  $p < 0.001$ , multivariate partial eta squared = 0.06. Post-hoc pairwise comparisons showed significant differences in SMU Time between 12 ( $M = 1.60$ ,  $SD = 1.05$ ) and 20 ( $M = 1.78$ ,  $SD = 1.12$ ) weeks of pregnancy ( $p < 0.001$ ) and 12 and 28 ( $M = 1.79$ ,  $SD = 1.17$ ) weeks of pregnancy ( $p < 0.001$ ). No differences were found between 20 and 28 weeks of pregnancy.

Furthermore, there was also a significant change in SMU Frequency over time, Wilks' Lambda = 0.99,  $F(2, 1133) = 5.14$ ,  $p = 0.006$ , multivariate partial eta squared = 0.01. Post-hoc pairwise comparisons showed significant differences in SMU Frequency between 12 ( $M = 19.79$ ,  $SD = 11.1$ ) and 20 ( $M = 20.42$ ,  $SD = 11.1$ ) weeks of pregnancy ( $p = 0.038$ ) and 12 and 28 ( $M = 20.56$ ,  $SD = 11.1$ ) weeks of pregnancy ( $p = 0.007$ ). No differences were found between 20 and 28 weeks of pregnancy.



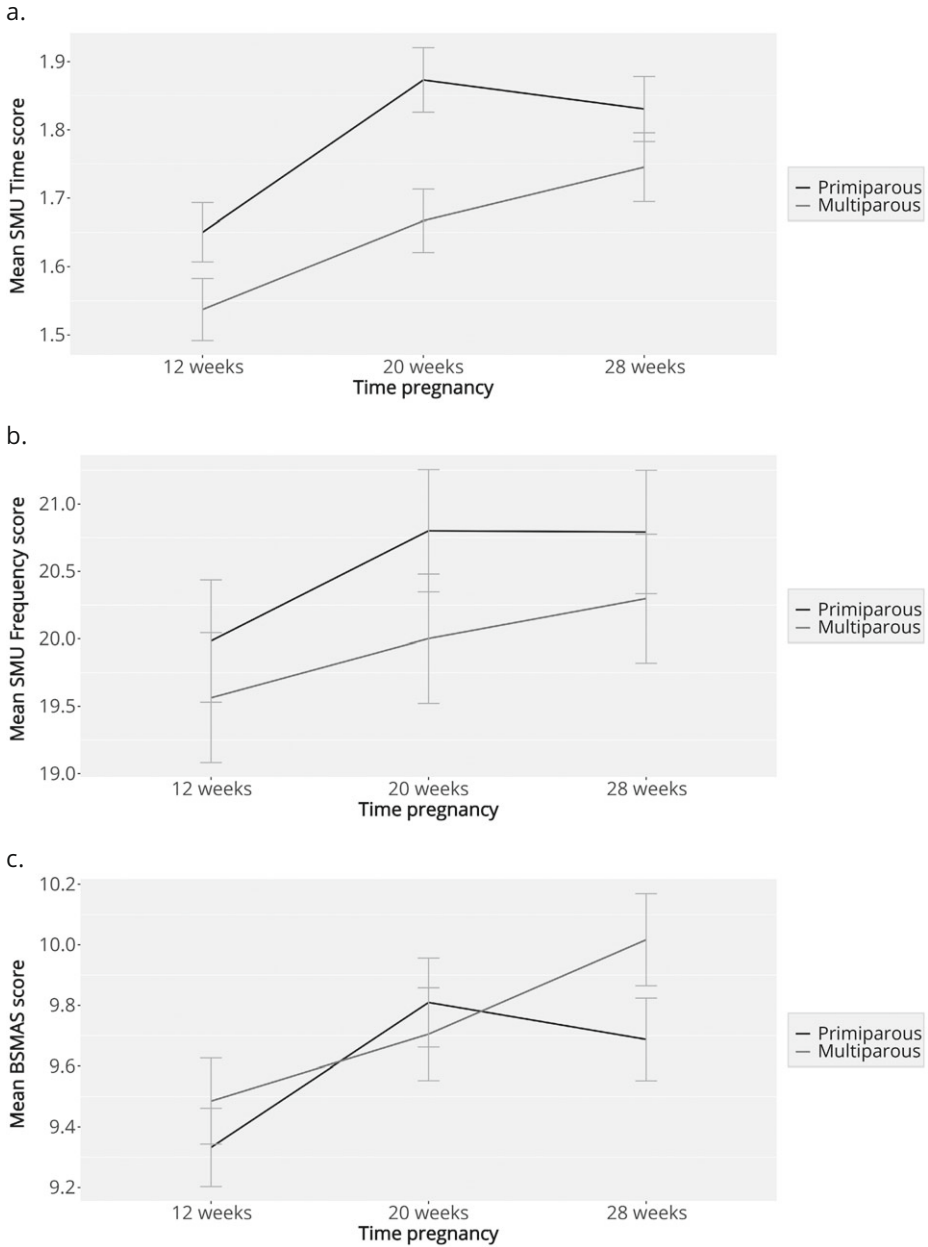
Lastly, a significant change in BSMAS scores was also demonstrated, Wilks' Lambda = 0.97,  $F(2, 1133) = 17.39$ ,  $p < 0.001$ , multivariate partial eta squared = 0.030. Significant differences were found between 12 ( $M = 9.40$ ,  $SD = 3.22$ ) and 20 ( $M = 9.76$ ,  $SD = 3.57$ ) weeks of pregnancy ( $p < 0.001$ ) and 12 and 28 ( $M = 9.84$ ,  $SD = 3.42$ ) weeks of pregnancy ( $p < 0.001$ ). No differences were found between 20 and 28 weeks of pregnancy.

### **Differences in social media use according to parity**

Results of the mixed between-within subjects ANOVA showed that there was a significant interaction between parity and time for SMU Time, Wilks' Lambda = 0.99,  $F(2, 1132) = 3.61$ ,  $p = 0.027$ , multivariate partial eta squared = 0.006. T-tests showed that SMU time was significantly higher in primiparous ( $M = 1.87$ ,  $SD = 1.16$ ) compared to multiparous ( $M = 1.67$ ,  $SD = 1.07$ ) women, at 20 weeks of pregnancy only,  $t(1133) = 3.10$ ;  $p = 0.002$ , Cohen's  $d = 0.184$ . See Figure 3a.

Furthermore, there was no significant difference in the course of SMU Frequency between primiparous and multiparous women, Wilks' Lambda = 0.999,  $F(2, 1132) = 0.32$ ,  $p = 0.726$ , multivariate partial eta squared = 0.001. T-tests also did not show significant differences. See Figure 3b.

The last analysis showed a significant interaction between parity and time for the BSMAS, Wilks' Lambda = 0.99,  $F(2, 1132) = 4.08$ ,  $p = 0.017$ , multivariate partial eta squared = 0.007. T-tests did not show any significant differences between the two groups. See Figure 3c.



**Figure 3.** Mean social media use scores at 12, 20 and 28 weeks of pregnancy for SMU Time (panel a), SMU Frequency (panel b) and the BSMAS (panel c) for primiparous and multiparous women

*Note.* SMU, Social Media Use; BSMAS, Bergen Social Media Addiction Scale. Error bars are standard error of the mean

## Discussion

This longitudinal study is among the first showing a linear increase throughout pregnancy of three types of social media use (SMU Time, SMU Frequency and the BSMAS). In the current study, 10.5% of pregnant women were possibly addicted to social media. Primiparous women spent more time on social media than multiparous women, but only in the second trimester. Primiparous and multiparous women did not differ in frequency or problematic use of social media.

The current study showed that social media use was the lowest in the first trimester of pregnancy, which is not completely in line with our expectations. Based on previous literature, we expected to find a U-shape patterns of social media use during pregnancy. More specifically, we expected to find higher social media use in the beginning of pregnancy. Many women keep their pregnancy a secret in the first trimester because of a higher risk for miscarriage. These women often search online for information and to share their experiences<sup>21,22</sup>, possibly resulting in increased use. In addition, we expected higher social media use in the third trimester, because of reduced mobility and changes in social and work-related activities. Women in their third trimester might use social media to compensate for not having many live contacts<sup>23</sup>. Our results were not in line with our first expectation as we did not find higher scores in the first trimester. This might be because pregnant women use other sources to find information regarding their pregnancy instead of using social media. A recent narrative literature review stated that although social media is a common source to look up pregnancy-related information, the exact percentages vary greatly across different studies<sup>32</sup>. This review also notes that many studies found women using search engines on the internet most frequently to find answers to their pregnancy-related questions<sup>32</sup>. For the current study, this could imply that women might still use the internet often at the beginning of their pregnancy, but not necessarily social media platforms.

Furthermore, the results of the current study showed that social media use did not differ according to parity, but that primiparous women did spend more time on social media in the second trimester. Primiparous women often experience more pregnancy-related worries and anxiety in comparison to multiparous women, who already have experience with being pregnant as well as childbirth<sup>24-26</sup>. This might

explain why primiparous women spent more time on social media, in order to search online for pregnancy-related support and information. Why we only found a difference between primiparous and multiparous women at 20 weeks of pregnancy, and not at 12 and 28 weeks, needs to be addressed in future research. This is important, as this increase in social media use could have negative effects on the mental health of pregnant women, for example it could lead to more symptoms of depression, anxiety and stress<sup>14,15</sup>. The use of social media has increased over the past years<sup>1,2</sup>. Almost everyone in the Netherlands aged between 25 and 45 years uses social media nowadays<sup>2</sup>. Moreover, in the current study, the percentage of women scoring above the cut-off of potential social media addiction was 10.5%, making this group of pregnant women extra vulnerable. These women might need to be carefully monitored by healthcare professionals, as associations between excessive social media use with poor mental health and poor sleep outcomes have been found<sup>33</sup>. Both optimal mental health and good sleep quality of pregnant women is of the utmost importance for both the mother and the fetus<sup>27,34</sup>.

The current study has strengths and limitations. Important strengths of this study are the relatively large sample size (N = 1135) and the longitudinal design with assessments of social media use at each trimester. Furthermore, regarding obstetric parameters, such as parity, age, and number of previous miscarriages, the current sample is similar to the National Dutch birth figures<sup>35</sup>. A limitation of this study is that social media use was measured by self-report, which may have caused retrospective bias<sup>36</sup>. Future research could use the experience sampling method, which could serve as a more direct method to register social media use<sup>36,37</sup>. Smartphone data can also be used to assess patterns of social media use<sup>38</sup>. Also, we did not specify the type of social media used. For example, the use of pregnancy support apps (with discussion forum) may be seen as social media by some, but not by others. Moreover, we did not ask what kind of content the women consumed on social media. Future research could focus on the motivations of women to use social media during pregnancy, for example for reassurance, social support, relaxation, or to learn about pregnancy, and the possible association with positive and negative feelings, such as feeling more content, happy, anxious, or worried. Furthermore, social media use during pregnancy was assessed at 12, 20 and 28 weeks of pregnancy. It would have been interesting to have an additional assessment around 36 weeks of pregnancy, when all women in the Netherlands are on pregnancy leave. At that time, pregnant women

might use more social media, due to increased spare time and (potential) reduced mobility. Another limitation is that our sample included predominantly white, Dutch women who were more often highly educated, compared to the national figures<sup>39</sup>. This may limit the generalizability of the results.

For future research it might be relevant to gain a comprehensive understanding of the motives of women for utilizing social media during pregnancy as well as the adverse and beneficial effects they may encounter. This can be researched by a qualitative study to gain more insight in women's thought processes and experiences. Besides that, it might be beneficial to conduct a quantitative study to further investigate the associations between specific motivations to use social media during pregnancy and negative outcomes. For example, it would be interesting to know whether spending time catching up with friends and family members on social media would have the same impact on the mental health of pregnant women as compared to seeking parenting advice and support from strangers who may express opposing opinions to one's personal opinions and beliefs. In the current study, social media was assessed as one construct, rather than splitting it into different social media types (Facebook, Instagram, pregnancy-apps, etc.) and/or aspects (posting photos/videos, browsing content, interacting/responding, etc.). It could be, however, that specific types and/or aspects of social media use show a different pattern over time during pregnancy and might be uniquely associated with specific mental health outcomes. Therefore, future research should focus on differentiating these potential effects.

In conclusion, our findings indicate that pregnant women use more social media as pregnancy progresses and that primiparous women spent more time on social media in the second trimester compared to multiparous women. One out of ten pregnant women were potentially addicted to social media, which is of importance for healthcare professionals, because of its association with negative mental health outcomes, such as more symptoms of depression, anxiety and stress<sup>14,15</sup>. Additionally, more research should focus on investigating the underlying mechanisms of the association between problematic social media use and mental health issues, specifically in pregnant women.

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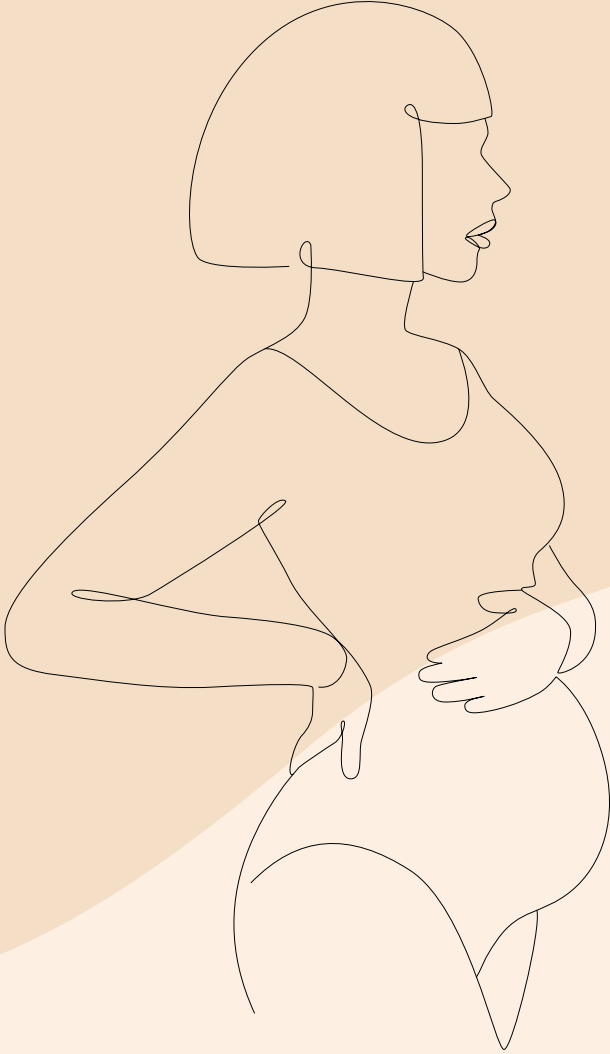
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# Chapter 5

## **Motives and consequences of social media use during pregnancy: a qualitative study**

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Under review

## Abstract

**Background:** Over the past years, the number of social media users has rapidly increased. Previous research has shown associations between social media use during pregnancy and mental health problems.

**Aim:** The current study investigates the motives of pregnant women to use social media during pregnancy, the possible changes in social media use, and the positive and negative consequences.

**Methods:** Eleven individual in-depth semi-structured interviews were conducted with women who reported problematic social media use during pregnancy. Interviews were coded inductively and codes were organized into themes using thematic analysis. Motives to use social media during pregnancy were also assessed using the Social Media Usage Aims Scale in these women.

**Results:** The interviews revealed three main themes: content consumed during pregnancy, motives for social media use during pregnancy and consequences of social media use during pregnancy. The third main theme consists of three subthemes: consequences of comparison to others, consequences of using social media as an information source and negative feelings as a direct consequence of social media use. The questionnaire data showed that the motives passing time, maintaining existing relationships, for entertainment and for informational and educational purposes were the most important motives to use social media during pregnancy.

**Conclusion:** The results of the current study underscore the contemporary importance of social media in the lives of pregnant women and shed light on the potential consequences. These findings can enhance healthcare professionals' awareness of the motives and consequences of social media use, enabling them to provide better support.

## Introduction

Over the past six years, the number of social media users has nearly doubled worldwide from 2.73 billion users in 2017 to 4.89 billion users in 2023<sup>1</sup>. Specifically in the Netherlands, almost everyone (96%) between 25 and 45 years old uses social media<sup>2</sup>. Therefore, there is a high probability that almost all pregnant women use social media in their daily lives. Social media use can provide social and emotional support for pregnant women<sup>3,4</sup>. Pregnancy can be a very challenging period for many women, due to many psychological, social, and physical changes. Social media can be very helpful during this stressful period. Many pregnant women use the internet and social media to find answers to their questions and advice related to pregnancy and parenting<sup>5</sup>. Social media is a form of social support to many women in the perinatal period. However, the use of social media during pregnancy has also been associated with negative consequences. For example, Facebook use during pregnancy has been associated with higher body image concerns, and increased body image dissatisfaction<sup>6</sup>. Furthermore, previous studies have found associations between digital media use and more self-criticism, lower quality of life and higher negative affect during pregnancy<sup>4</sup>. Moreover, previous research even showed that both higher intensity of social media use and problematic social media use were associated with higher levels of depressive symptoms during pregnancy<sup>7</sup>. In a cross-sectional study by Mo et al.<sup>8</sup>, an association between the use of prenatal care apps, more specifically, the availability of disease-screening functions and spending more time on it, and antenatal depression was found. Antenatal depression has implications for both the mother and the child, as it is associated with postpartum depression and can have a potential impact on fetal outcomes, including premature birth, low birth weight, and intrauterine growth restriction, while it has also been shown to have an influence on infant development<sup>9-12</sup>. Therefore, it is important to understand the exact pathways from social media use to mental health issues in pregnant women.

Several studies have investigated how and for what purposes pregnant women use social media. In their systematic review, Gleeson et al.<sup>13</sup> found that online groups for childbearing women are primarily used to seek information, although women also value the convenience, anonymity, and the opportunity to find support and connect to others who share similar experiences. A study by Lee and Lee<sup>14</sup>, also

found that social media is often used for pregnancy-related health information and emotional support. However, there is a lack of research that investigates what motivates women to use social media during pregnancy and how women's thoughts, feelings and emotions are affected using social media, combined in one single study.

To our knowledge, the current study is the first study to assess the *motives* of pregnant women to use social media during pregnancy and its possible *positive and negative consequences*, in a qualitative research design using individual in-depth semi-structured interviews. The aim of this study is to gain a comprehensive understanding of the motives of women for utilizing social media during pregnancy, the possible changes in social media use, as well as the adverse and beneficial effects that they may encounter during this critical period.

## Methods

### Participants

Participants for this study were recruited from a larger prospective cohort study conducted at Tilburg University: the Brabant Study<sup>15</sup>. The Brabant Study has been approved by the Medical Ethics Committee at the Máxima Medical Centre Veldhoven (NL64091.015.17) and the current sub-study by the Ethical Review Board of Tilburg University (TSB\_RP527). As part of the Brabant Study, problematic social media use was assessed in all trimesters of pregnancy (12, 20 and 28 weeks) using the Bergen Social Media Addiction Scale (BSMAS)<sup>16,17</sup>. This scale was used to screen women for problematic social media use for the purpose of the current study. Women who scored above the suggested cut-off of the BSMAS (scoring 3 or above on at least four of the six BSMAS items<sup>17</sup>) at least once during their pregnancy between April 2021 and April 2022 were eligible to participate. Both pregnant women as women who recently gave birth could participate in the current study. Eligible women were invited via e-mail. After agreeing to participate, an appointment for the online interview was scheduled. Participants were included in the study until data saturation was reached. All participants provided informed consent.

In total 64 women were contacted to participate in the current study of whom 12 were interested in participation. Due to an insufficient understanding of the Dutch language, one woman was excluded from the analyses due to misunderstanding

and miscommunication between the interviewer and participant. Therefore, the final sample for this study consisted of 11 women.

## **Procedures**

In June and July 2022, eleven in-depth, individual semi-structured interviews were conducted by the first (LM) and last (MB) author. The interviews were held in the online environment Zoom and were audio recorded. An interview script was used by the researchers to make sure all topics were discussed during the interviews. However, follow-up questions could be asked by the researchers to stimulate more in-depth responses. After the interview, all participants received an online questionnaire via Qualtrics to collect data on demographics, their current social media use and mental wellbeing. To thank the participants for their participation and effort, they received a gift voucher worth five euros and a small present for their child.

### **Semi-structured individual interview**

The participating women who already gave birth were asked to reflect on their experiences during pregnancy. During the semi-structured individual interviews, participants were asked what kind of social media platforms they used and how frequently they used these platforms during pregnancy. Also, questions were asked about the purposes and motivations of social media use during their pregnancy (e.g., *“What were the most important reasons for you to use social media during pregnancy?”*). Furthermore, women were asked how their thoughts, feelings and emotions were affected by social media use during pregnancy, both positively as negatively (e.g., *“What kind of feeling does using social media give you?”*). Lastly, women were asked if they experienced other negative consequences of social media use during pregnancy (e.g., *“Are there any (other) negative consequences of using social media?”*).

## **Measures**

### ***Demographic and pregnancy-related characteristics***

In the online questionnaire (Qualtrics Software), information on maternal demographic characteristics (e.g., age, educational level, work), pregnancy and the child (e.g., duration pregnancy, age of the child), and the partner (e.g., educational level, work) were reported on.

***Problematic social media use***

The six-item Bergen Social Media Addiction Scale (BSMAS) was used to assess problematic social media use during pregnancy<sup>16,17</sup>. Each item was measured on a five-point Likert-type scale ranging from 1 (very rarely) to 5 (very often). Total scores range from 6 to 30, with higher scores indicating more problematic social media use. A cut-off score of 3 or above on at least four of the six items was used to indicate a *potential social media addiction*<sup>17</sup>. The BSMAS has shown acceptable psychometric properties<sup>16</sup>.

***Social media use motives***

To measure motives for social media use during pregnancy the 30-item Social Media Usage Aims Scale (SMUAS) was used<sup>18,19</sup>. Women who already gave birth were asked to reflect on their motivations to use social media during their pregnancy (*"During my pregnancy I used social media to ..."*). This scale consists of seven subscales: maintaining existing relationships (MER) (4 items), meeting new people and socializing (MNPS) (4 items), making, expressing, or presenting a more popular oneself (MEPO) (4 items), passing time (PT) (3 items), as a task management tool (ATMT) (5 items), for entertainment (ENT) (4 items), and for informational and educational purposes (IAE) (6 items). Each item was measured on a five-point Likert-type scale ranging from 1 (totally disagree) to 5 (totally agree). The total scores of the subscale PT ranged between 3 and 15, the total scores of the subscales MER, MNPS, MEPO, and ENT between 4 and 20, the total scores of the subscale ATMT ranged between 5 and 25 and the total score of IAE between 6 and 30. The scale has been shown to be a valid and reliable instrument<sup>18,19</sup>.

***Depressive symptoms***

The Dutch version of the ten-item Edinburgh Depression Scale (EDS) was used to assess depressive symptoms<sup>20-22</sup>. Total scores range from 0 to 30 and higher scores reflect more depressive symptoms. A cut-off score of > 12 for depression has been described during pregnancy and postpartum<sup>21,23</sup>. The EDS has shown to have good reliability and validity to measure depressive symptoms during pregnancy and postpartum<sup>20,22</sup>.



## Data analyses

All interviews were audio recorded and transcribed clean verbatim. Atlas.ti software (version 22) was used for the coding and analysis process. Transcripts were coded inductively. The first two interviews were coded independently by the first (LM) and last (MB) author and subsequently compared until agreement was reached. Thereafter, a codebook was established, and the remaining interviews were coded by LM and checked by an independent third-party reader (research assistant). Next, the codes were organized into themes using thematic analysis by the first (LM), second (MvdH) and last (MB) author<sup>24</sup>. Themes were revised until agreement between all authors was reached. The questionnaire data was analyzed by calculating the total and mean scores of the participants.

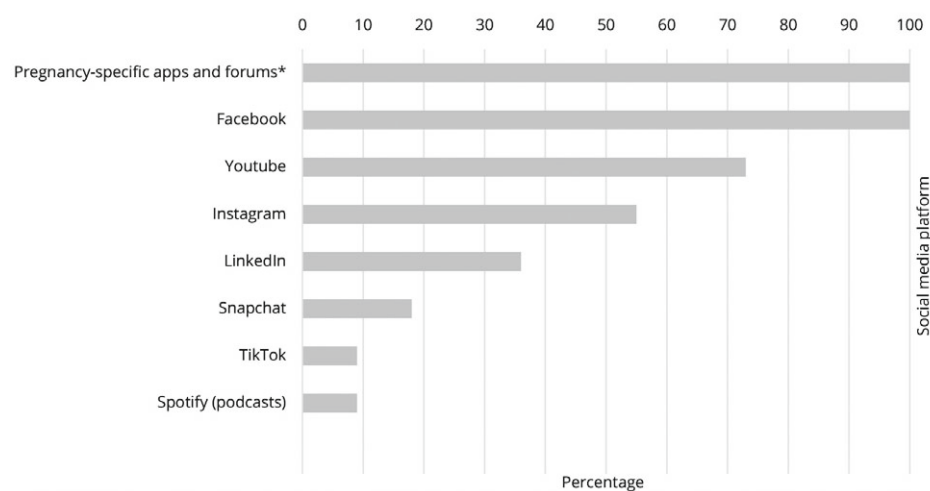
## Results

On average the interviews lasted 16.74 minutes (range 11.15 – 27.32 minutes). Table 1 shows the demographic characteristics and mean variable scores of the sample. Three interviews were conducted with pregnant women and eight interviews with women who had recently given birth (months postpartum ranging between 2 and 9 months). Participating women had a mean age of 30.55 years (SD = 2.3) and all participants (100.0%) had a partner. Most women were highly educated (Bachelor's degree or higher) (72.7%) and were employed (81.8%). Figure 1 illustrates the social media platforms used by the participating women. All participants used pregnancy-specific apps and forums (100%) and Facebook (100%). Table 2 shows the results of the questionnaire data of the participating women. Five of the eleven women scored above the cut-off score on the BSMAS and two of the eleven women scored above the cut-off score on the EDS, at the time the interviews were conducted. Women reported that the motives *passing time* (M = 4.00, SD = 0.71), *maintaining existing relationships* (M = 3.18, SD = 1.25), for *entertainment* (M = 2.95, SD = 0.93) and for *informational and educational purposes* (M = 2.91, SD = 0.83) were the most important, while *making, expressing, or presenting a more popular oneself* (M = 2.05, SD = 0.82), *meeting new people and socializing* (M = 2.36, SD = 0.77) and *as a task management tool* (M = 2.64, SD = 0.87) were less important motives for women of the current study to use social media during pregnancy.

**Table 1.** Participant characteristics at time of interview.

Participant	Age	Partner	Educational level <sup>a</sup>	Paid job	Weeks pregnant	Months postpartum	Number of children
P1	29	Yes	High	Yes	36		0
P2	30	Yes	Low	Yes		5	2
P3	27	Yes	High	Yes		4	1
P4	34	Yes	High	Yes	36		1
P5	32	Yes	High	Yes		6	2
P6	32	Yes	High	No		3	3
P7	31	Yes	Low	Yes		9	1
P8	28	Yes	High	Yes		4	1
P9	29	Yes	High	Yes	31		0
P10	34	Yes	High	Yes		2	1
P11	30	Yes	Low	No		5	1

Note. <sup>a</sup>High: Bachelor's degree or higher



**Figure 1.** Social media platforms used by the participants, from most used (top) to fewest used (bottom)

\*Note. Such as 24baby (<https://www.24baby.nl/>), Zwangerschap+ [Pregnancy+] (<https://philips-digital.com/nl/pregnancy-new/>), Ouders van Nu [Parents of Today] (<https://forum.oudersvannu.nl/>)

Table 2. Questionnaire data.

Participant	BSMAS <sup>a</sup>	Above cut-off BSMAS <sup>b</sup>	EDS <sup>c</sup>	Above cut-off EDS <sup>d</sup>	MER <sup>e</sup>	NMPMS <sup>f</sup>	MEPO <sup>g</sup>	PT <sup>h</sup>	ATMT <sup>i</sup>	ENT <sup>j</sup>	IAE <sup>k</sup>
P1	13	No	5	No	3.00	2.25	2.00	4.67	2.60	2.00	2.83
P2	12	No	3	No	4.25	2.50	3.75	4.00	3.80	4.50	2.67
P3	15	No	7	No	3.50	3.00	3.25	4.33	3.60	3.25	4.00
P4	15	No	13	Yes	2.75	1.75	2.00	4.00	2.00	3.00	2.50
P5	6	No	2	No	1.00	1.50	1.00	3.00	1.60	1.75	2.00
P6	19	Yes	15	Yes	3.50	3.25	2.00	5.00	3.60	2.50	4.00
P7	17	Yes	11	No	3.75	3.00	1.75	3.00	2.20	2.75	3.50
P8	20	Yes	3	No	4.50	2.75	2.00	3.67	1.80	3.25	2.50
P9	21	Yes	10	No	3.00	1.75	2.00	3.33	2.60	3.50	2.67
P10	21	Yes	3	No	1.00	1.00	1.00	4.00	1.60	1.75	1.50
P11	17	No	12	No	4.75	3.25	1.75	5.00	3.60	4.25	3.83
Mean (SD)	16.00 (4.52)		7.64 (4.72)		3.18 (1.25)	2.36 (0.77)	2.05 (0.82)	4.00 (0.87)	2.64 (0.87)	2.95 (0.93)	2.91 (0.83)

Note. <sup>a</sup> Total BSMAS scores; range 6-30

<sup>b</sup> Cut-off BSMAS; scoring 3 or above on at least four of the six BSMAS items

<sup>c</sup> Total EDS scores; range 0-30

<sup>d</sup> Cut-off EDS; > 12

<sup>e</sup> Mean subscale maintaining existing relationships – SMUAS; range 1-5

<sup>f</sup> Mean subscale meeting new people and socializing – SMUAS; range 1-5

<sup>g</sup> Mean subscale making, expressing, or presenting a more popular oneself – SMUAS; range 1-5

<sup>h</sup> Mean subscale passing time – SMUAS; range 1-5

<sup>i</sup> Mean subscale as a task management tool – SMUAS; range 1-5

<sup>j</sup> Mean subscale entertainment – SMUAS; range 1-5

<sup>k</sup> Mean subscale informational and educational purposes – SMUAS; range 1-5

## Thematic results

The thematic analyses of the interviews revealed three main themes: 1) *content consumed during pregnancy*, 2) *motives for social media use during pregnancy* and 3) *consequences of social media use during pregnancy*. The theme *consequences of social media use during pregnancy* consists of three subthemes: *consequences of comparison to others*, *consequences of using social media as information source* and *negative feelings as a direct consequence of the use of social media*. See Figure 2 for a graphical overview of the main themes and subthemes.

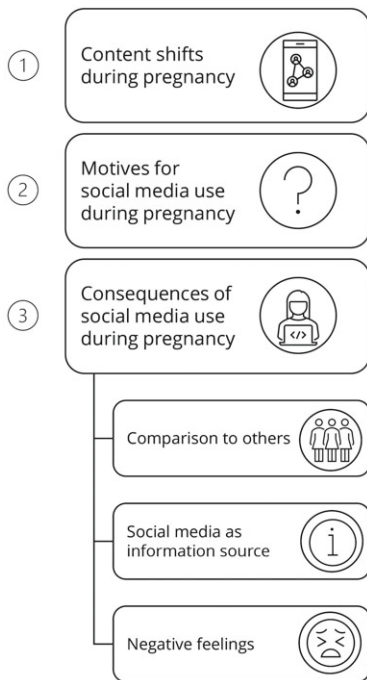


Figure 2. Overview of main themes and subthemes

### **Theme 1: Content shifts during pregnancy**

The social media content women consumed during their pregnancy differed from the content consumed prior to their pregnancy. The content shifted more towards *pregnancy-related topics*. Almost all women mentioned that they started using pregnancy-related platforms when pregnant and were more interested in following other pregnant women or pregnancy-related profiles on social media. One participant explained this content shift as: *'Now it [the social media content] has also moved more*

towards pregnancy... how other people do certain things and what the possibilities are, which I think is more interesting now' (P9). Furthermore, participants also reported that their social media algorithm changed during their pregnancy, for example, that they automatically were exposed to more videos about babies and pregnancy-related information.

The *type of content* pregnant women engaged with on social media *shifted* as they progressed from the first to the third trimester of pregnancy. At the beginning of their pregnancy, women were more interested in topics such as pregnancy in general, information about the different trimesters, nausea, pregnancy complaints, and information on dietary restrictions. Towards the end of their pregnancy, women started to follow social media profiles of women who recently gave birth and were more interested in topics related to childbirth and breastfeeding. One woman explained that the type of content changed over the course of pregnancy: '*At the end, I engaged more in information about giving birth and about breastfeeding, and things like that. In the beginning, I think it [social media engagement] was mostly focused on the symptoms you had, looking up something about a symptom, and indeed in terms of food, what you can and cannot have*' (P7).

Some women also explained that they consciously *avoided* certain *content on social media*. Women unfollowed or blocked specific persons on social media because it gave them negative feelings. One participant explained: '*I unfollowed some people because they were really busy with everything every day. And then I thought: I really don't like this, because it gave me a negative feeling. Because of the many posts, I feel like you end up in a negative spiral wondering whether I am doing it right. So then I just unfollowed people*' (P8). The type of content they described to be unpleasant ranged from posts about diseases, information on do's and don'ts during pregnancy, as well as food preparation videos, which made one woman feel nauseous. Conversely, one woman mentioned that she consciously searched for positive content on social media. She explained that she searched for people who shared their positive childbirth experiences.

### ***Theme 2: Motives for social media use during pregnancy***

All women gave numerous reasons why they used social media during their pregnancy. The main motive that emerged from the interviews was *to obtain information* during

pregnancy. Almost all women reported *obtaining information* and *inspiration* as motivations to use social media during their pregnancy. They used social media to read up on a certain topic, to know what to expect during their pregnancy, to gather information on the development of the baby in their womb, to ask questions and look up information for reassurance. Additionally, they were interested in what others wrote about being pregnant, their experiences, and practical life hacks and useful tips. Women also mentioned that it was helpful to read about certain problems that others also encountered during pregnancy and information about how things are arranged, such as childbirth. One woman used social media to educate her children about the unborn baby, for example by showing the unborn baby's size at specific timepoints in pregnancy. It was also mentioned that information on dietary guidelines, certain complaints such as itching and bleeding, recommendations for useful products, and sensations and appearances during pregnancy, were searched for on social media. Thus, women use social media during pregnancy to gather a wide range of information.

Furthermore, nearly all women mentioned that their motivations to use social media during pregnancy were related to *comparison to others* and *peer-experiences*. The women often looked at the social media profiles of others in order to compare themselves to them, aiming to find out whether their situation was unusual or just common. One woman liked being able to share certain feelings and doubts with others. The women expressed that they were interested in what others encountered, how they handled specific problems, and other's perspectives on pregnancy-related subjects. The women also found it helpful seeing life hacks and tips from others and finding out what to expect during their pregnancy. Recognition was mentioned as an important feeling here. When asked to describe positive outcomes resulting from the use of social media during pregnancy, one woman explained: *'Recognition. I also find it quite comforting to encounter the things I come across in others. I happen to have one friend who is also pregnant, but during my first pregnancy, I was the first to get pregnant of my friends. Then it is really nice to see that other people recognize certain symptoms, feelings and behaviors. So, the recognition is a positive side of using social media'* (P4). However, a few women also mentioned that they liked to see that they had it better, or easier, than other pregnant women.

Moreover, many women explained that they used social media during their pregnancy because they felt *addicted* to it, out of *boredom*, for *leisure* or because it was a *habit* to them. One woman explained this as follows: *'Entertainment for boredom because I was dealing with severe preeclampsia complications and symptoms. I could not do anything, so for me, social media was a way to step out of the bubble, just for a little while. It may sound a bit silly, but for me, it was genuinely a pleasant escape from the everyday'* (P11).

A few women also explained that they used social media during their pregnancy to *share information* and tips with others. Furthermore, half of the women stated that they used social media to *stay up to date* and to *stay in touch with friends and family*: *'For example, sending each other [friends and family] Snapchats of what you are currently doing or sharing what you are experiencing at the moment'* (P7), and to keep others up to date: *'Facebook is really for keeping family and friends informed about the progress of the pregnancy'* (P11).

### **Theme 3: Consequences of social media use during pregnancy**

Three subthemes emerged from the interviews about the consequences of social media use during pregnancy: 1) consequences of comparison to others, 2) consequences of using social media as an information source and 3) negative feelings as a direct consequence of social media use.

#### **Subtheme 3.1: Consequences of comparison to others**

The first consequence of using social media during pregnancy, which emerged from the interviews, is that many women *compared themselves to others*. This can lead to both negative and positive feelings. On the one hand, some women mentioned that using social media during pregnancy could evoke feelings of *disappointment*, *insecurity*, *jealousy*, *sadness*, and *self-doubt*. One participant described this feeling of disappointment as follows: *'When things were not going so well, and when you see others who are happy and cheerful, then you want that too, and you might feel disappointed'* (P8). On the other hand, for half of the women, the use of social media enhanced feelings of *reassurance* and *recognition*. One participant explained: *'If they [other people on social media] gained five kilos by now, and I had as well, then I felt like things were going well. And if they, for instance, had three ultrasounds and I already had more ultrasounds, I also felt things were going well. It [the use of social media] was really for reassurance and monitoring'* (P2).



### **Subtheme 3.2: Consequences of using social media as an information source**

Using social media as an information source can also lead to both negative and positive feelings during pregnancy. According to half of the women, it can cause feelings of *anxiety, confusion, guilt, and insecurity*. One woman explained what specific kind of content gave her negative feelings: *'Well, mainly those "ten tips to prevent this or that" make me feel like something is my fault. For example, the ten tips to turn your baby or the ten tips to avoid him [the baby] getting certain abnormalities. Whereas I also think that I am following the advice of my midwife, and that should be sufficient. So it [certain content on social media] quickly makes me feel like: I am doing something wrong, I have overlooked something, I should have eaten, moved, or thought differently'* (P4). Nevertheless, a positive consequence of using social media as information source some women mentioned is the sense of *reassurance*. These women indicated they found it useful to be able to look on social media for tips and answers to their questions, which created feelings of reassurance.

### **Subtheme 3.3: Negative feelings as a direct consequence of social media use**

Many women in this study mentioned various direct negative feelings they experienced due to the use of social media throughout their pregnancy. Some women expressed feelings of *boredom* and *emptiness*. They also felt social media use was sometimes a *waste of time*, which sometimes induced feelings of *guilt*. One woman explained: *'I find it frustrating that I spend too much time on it [social media]. It also feels somewhat useless. And sometimes, I end up scrolling through it [social media] longer than I would like, so that irritates me'* (P9). For some women the use of social media during pregnancy also caused feelings of *frustration, insecurity, restlessness, and feelings of upset*. One woman said: *'I find it especially frustrating that the positive things are mentioned, but the less pleasant things are often left out. I just find that annoying, because then I think: "those are part of it too". And as a young mother, I find it important to know about those as well'* (P7). One woman felt *neutral* towards the use of social media: *'I think quite neutral. I am aware that childbirth unfolds as it does, and you have to be able to adapt mentally to it. ... I cannot say that I was really super happy because of it [social media use] or super down'* (P6). The interviews thus revealed a variety of negative feelings as a direct consequence of the use of social media during pregnancy.

## Discussion

The current study aimed to gain a comprehensive understanding of women's motives to utilize social media during pregnancy, the possible changes in social media use, as well as the adverse and beneficial effects that they may encounter. To this end, individual in-depth semi-structured interviews were conducted, and questionnaire data was used to complement this qualitative data. In the current study, the results from the questionnaire data showed that the main reasons for the pregnant women to use social media were for passing time, for maintaining existing relationships, for entertainment and for informational and educational purposes. Results also showed that making, expressing, or presenting a more popular oneself, meeting new people and socializing, and as a task management tool were reported to be less important motives. Next, the inductive thematic analysis of the interviews revealed three main themes regarding the use of social media during pregnancy: 1) content shifts during pregnancy, 2) motives for social media use during pregnancy and 3) consequences of social media use during pregnancy. This third main theme was further divided into three subthemes: consequences of comparison to others, consequences of using social media as an information source and negative feelings as a direct consequence of social media use.

The first main theme identified important social media content shifts during pregnancy. The social media content women consumed before they were pregnant differed from the content they viewed during their pregnancy. During pregnancy women were more interested in pregnancy-related topics. Furthermore, the type of content pregnant women viewed during their pregnancy also shifted as pregnancy progressed from the beginning until the end of pregnancy. Previous studies also found interests to shift before and during pregnancy. For example, Guntuku et al.<sup>25</sup> evaluated whether there was variability in the language used on social media before, during and after pregnancy, and found that social media posts during pregnancy more often included themes about family (e.g., "parents", "babies"), food cravings (e.g., "hungry", "starving"), and date/times (e.g., "first", "month"). Furthermore, Guntuku et al.<sup>25</sup> found that posts three months prior to pregnancy more often included themes about social life (e.g., "party", "Friday") and sleep (e.g., "bed", "sleepy"). Furthermore, a Swedish study found that more than half of the pregnant women were more inclined to search for health information related to pregnancy

and childbirth in the beginning of their pregnancy, rather than towards the end of their pregnancy<sup>26</sup>.

The interviews and questionnaire data further revealed that pregnant women used social media during their pregnancy for different reasons. First, women used social media for obtaining information and inspiration regarding pregnancy and delivery. Previous research has also highlighted the importance of this finding. In a focus group study, Lupton<sup>27</sup> concluded that digital information is of great importance to pregnant women, specifically for increased, readily available access to information and support from healthcare professionals. Secondly, results showed that comparing oneself to others and looking up peer-experiences was an important motivation. The finding is echoed by Lupton<sup>27</sup>, who found that emotional support and connection offered by fellow online mothers was important to pregnant women. In their study, Lupton<sup>27</sup> mentioned that online discussion fora enabled women to seek reassurance from women who had experienced similar events or problems. Third, results of the current study showed that addiction, boredom, leisure, and social media being a habit, were important motivations for pregnant women to use social media. In line with these findings, a study in older adolescents regarding social network site use found that females, in comparison to males, scored higher on the motivations entertainment and passing time<sup>28</sup>.

Lastly, several consequences of social media use during pregnancy emerged from the interviews. The first consequence is that many women compared themselves to others on social media, which can lead to both negative (disappointment, insecurity, jealousy, sadness, and self-doubt) and positive (reassurance and recognition) feelings. Previous studies on social media use during pregnancy have also highlighted both these negative and positive feelings. A study on Facebook use during pregnancy, for instance, concluded that higher Facebook use predicted greater body image dissatisfaction due to self-comparison<sup>6</sup>. Conversely, Lupton and Pedersen<sup>29</sup> concluded that pregnancy and parenting apps are important to pregnant women as they indeed provide reassurance. It could be that the type of social media platform affects the way pregnant women feel when using the platform: while Facebook may make them feel insecure, pregnancy and parenting apps may empower them. More research that investigates multiple platforms is necessary to follow-up this statement.

Another consequence is using social media as an information source. In a recent systematic review by Chee et al.<sup>30</sup> on the impact of social media influencers on pregnancy, birth, and early parenting experiences, these potential beneficial and harmful effects for pregnant women were also found. On the one hand, it can provide potential for information sharing and support, however, on the other hand, influencers can easily provide misinformation, which might cause feelings of, for example, confusion and insecurity. Moreover, results of the current study also showed that women experience other direct negative feelings due to the use of social media throughout pregnancy. Feelings of boredom and emptiness were present, but women also felt social media was sometimes a waste of time, which could evoke feelings of guilt. Furthermore, feelings of frustration, insecurity, restlessness, and feelings of upset were important negative feelings which were reported in the current study due to the use of social media during pregnancy.

Many pregnant women use social media during their pregnancy, which can be very helpful and has been associated with many positive outcomes<sup>3-5</sup>. However, this study also highlights important negative outcomes and feelings due to the use of social media during pregnancy. These negative outcomes and feelings might be the underlying reason why higher social media use during pregnancy is associated with more depressive symptoms<sup>7</sup>, as negative feelings can lead to more depressive symptoms. Previous studies have already indicated an association between social media usage and negative feelings<sup>4,7</sup>. However, from these studies it remains unclear whether the negative feelings resulted in increased social media use or if heightened usage led to more negative feelings. The interviews conducted in this study shed light on this ambiguity, suggesting that women primarily experiencing negative feelings as a consequence of social media use, rather than the reverse direction. Therefore, it is of utmost importance for pregnant women, but also for healthcare professionals, such as midwives, to be aware of these negative outcomes and feelings caused using social media. The results of the current study could help healthcare professionals to provide pregnant women with better support and information regarding the use of social media during pregnancy.

The findings of the current study need to be considered in the context of a few limitations. First, most of the interviews were retrospective interviews with women who recently gave birth reflecting on their experiences during pregnancy. Furthermore,

the current study sample is not representative of the general Dutch population as most participants were highly educated and all participants had a partner, which might limit the generalizability of the results of the current study. Future research should aim to investigate a more diverse sample size, as personal background factors might influence the results. Moreover, a quantitative study could be valuable to further investigate the associations between specific motivations to use social media during pregnancy and negative outcomes in a larger sample. The most important strength of this study is the qualitative design. The qualitative data created a detailed understanding of the experiences of using social media during pregnancy, and the additional questionnaire data supported these findings.

### **Conclusion**

To conclude, the results of the current study revealed that the content women consume on social media shifts when they get pregnancy to more pregnancy-related topics and the type of content also shifts as pregnancy progresses. Furthermore, women mainly use social media during their pregnancy to obtain information, but also to compare themselves to others and to look up peer-experiences. Addiction, boredom, leisure, and habit are also often mentioned as motives to use social media by pregnant women. Women also reported to experience several positive and negative consequences of social media use. First, because pregnant women compare themselves to others. Secondly, because pregnant women use social media to obtain information and lastly, it can evoke direct negative feelings in general. The findings of this study underscore the contemporary importance of social media in the lives of pregnant women today. Healthcare professionals should increase their awareness of the motives and consequences of social media use among their pregnant patients, enabling them to provide better support if needed.

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# Chapter 6

**The COVID-19 outbreak increases  
maternal stress during pregnancy,  
but not the risk for postpartum depression**

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## Abstract

The COVID-19 pandemic affects society and may especially have an impact on mental health of vulnerable groups, such as perinatal women. This prospective cohort study of 669 participating women in the Netherlands compared perinatal symptoms of depression and stress during and before the pandemic. After a pilot in 2018, recruitment started on 7 January 2019. Up until 1 March 2020 (before the pandemic), 401 women completed questionnaires during pregnancy, of whom 250 also completed postpartum assessment. During the pandemic, 268 women filled out at least one questionnaire during pregnancy and 59 postpartum (1 March – 14 May 2020). Pregnancy-specific stress increased significantly in women during the pandemic. We found no increase in depressive symptoms during pregnancy nor an increase in incidence of high levels of postpartum depressive symptoms during the pandemic. Clinicians should be aware of the potential for increased stress in pregnant women during the pandemic.

## Introduction

The outbreak of the COVID-19 pandemic and subsequently the lockdown has had a substantial impact on society, especially for vulnerable groups in the population such as pregnant women. Pregnancy and the postpartum period are already vulnerable periods of time, which can co-occur with heightened levels of distress in many women<sup>1</sup>. Moreover, this pandemic has led to substantial changes in obstetric care, for example, the frequency of face-to-face consultations decreased during pregnancy<sup>2</sup>. Pregnant women had to deal with the anxiety of infection, along with many other uncertainties such as the concern that their partner may not be present at delivery. On top of that, there is very limited knowledge about the susceptibility or altered disease course for COVID-19 during pregnancy, and what the possible effect might be for the unborn child. The social distancing guidelines and travel restrictions may also have resulted in increased social isolation<sup>3,4</sup>. Consequently, it might have been difficult to bond with other pregnant women, also because of cancelled perinatal classes. Furthermore, postpartum women may not have been able to celebrate the birth of the baby with friends and family and had to deal with stress and exhaustion without assistance of friends, family, or professional caregivers due to the COVID-19 guidelines. Additionally, much time was spent at home during the pandemic, which in some cases has led to strained relationships with the partner during the pandemic<sup>3</sup>. In a Canadian study it was found that 18% of the women lost their job due to the COVID-19-pandemic<sup>3</sup>, which could have caused financial uncertainties. Together, these COVID-19-related changes have the potential to increase fear and worries in pregnant women<sup>5</sup>, and impact perinatal mental health.

Understandably, research on the impact of the COVID-19 pandemic on perinatal women's mental health is still very sparse. The first reports on this topic show higher prevalence of perinatal depression and anxiety during the COVID-19 pandemic, as compared to norm data before the pandemic, both in pregnant and postpartum women<sup>3,6</sup>. In another study, the incidence of high depression and high anxiety scores were higher in pregnant and postpartum women during pregnancy as compared to pre-pandemic scores that women retrospectively recalled<sup>7</sup>. During the pandemic, the incidence of maternal depression and anxiety was also found to be higher in mothers of children aged 0 to 8 years<sup>8</sup>. These studies show that perinatal women may be especially vulnerable to psychological distress during the COVID-19 pandemic.

Nonetheless, these studies have several major methodological shortcomings, particularly by using cross-sectional data, retrospective measurements and/or comparing pandemic data to norm data (no matching control group). On the other hand, Pariente et al.<sup>9</sup> found that postpartum women during the COVID-19 pandemic had a lower risk for high depression scores shortly after giving birth compared to a control group of women who gave birth a few years prior to the pandemic. In addition, Silverman et al.<sup>10</sup> found an improvement in depressive symptoms during pregnancy in women with low socioeconomic status, after the implementation of social restrictions compared to the early stages of the COVID-19 pandemic. While these studies provide important information, studies that are able to compare pregnant women during the pandemic with a matching control group of women that were pregnant *right before* the pandemic are necessary to make better inferences about the mental health effects of the pandemic on the pregnant population.

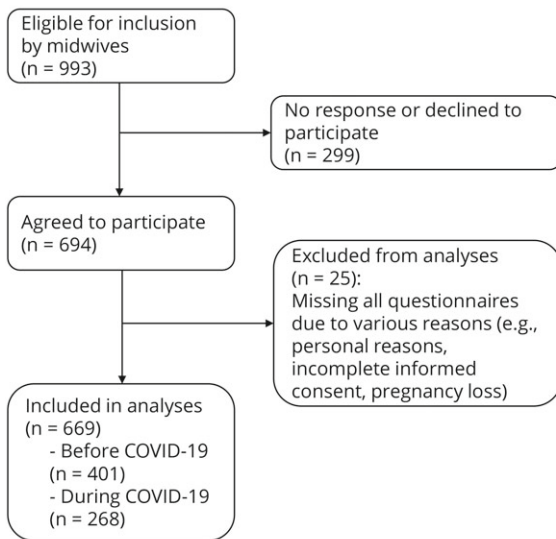
The current prospective cohort study from the Netherlands, the Brabant Study<sup>11</sup>, provides the unique opportunity to fill this gap. The Brabant Study is one of very few studies worldwide for which inclusion continued during the COVID-19 pandemic. The recruitment started in 2019 and continued during the pandemic, as well as during the three-month-long strict nationwide lockdown (March - May 2020). Moreover, Brabant is in the south of the Netherlands, which proved to be one of the pandemic epicenters in Europe. Consequently, the current study provides a unique opportunity to compare symptoms of depression and stress in the perinatal period during and right before the COVID-19 pandemic.

## Methods

### Participants and procedure

The current study is part of a longitudinal prospective cohort study (the Brabant Study)<sup>11</sup> among pregnant women who are followed from 12 weeks pregnancy until 10 weeks postpartum. Eligible pregnant women were recruited by community midwife practices and hospitals in Brabant, the Netherlands. After a pilot in 2018 (started 13 May 2018), recruitment started on 7 January 2019 and is still ongoing. Details on the design of the Brabant Study are described elsewhere<sup>11</sup>. In short, Dutch pregnant women (18+ years) who had their first antenatal visit before 14 weeks of gestation were eligible for participation. Exclusion criteria were: multiple pregnancy, known

endocrine disorder before pregnancy (other than thyroid function problems), diabetes type I, rheumatoid arthritis, severe psychiatric disease (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 adverse for the fetus and need careful follow-up during pregnancy. Moreover, women must have access to the internet. As reported by community midwives, 70% of the women who met inclusion criteria were willing to participate. This reflects 993 women to be eligible to participate up until mid-May 2020, of which 694 indicated that they were willing to participate. Women were included in the analyses if they had completed at least one questionnaire during pregnancy (12, 20 or 28 weeks of pregnancy). Of these 694 women, 25 (3.6%) failed to complete any of the three questionnaires during pregnancy due to various reasons (e.g., personal reasons, incomplete informed consent or pregnancy loss). See figure 1 for flowchart of participant inclusion.



**Figure 1.** Flowchart of participant inclusion

Participating women completed online questionnaires during all three trimesters of pregnancy and 8 to 10 weeks postpartum. Up until 1 March 2020, before the COVID-19 pandemic started in the Netherlands, 401 women completed questionnaires during pregnancy (trimester 1:  $n = 393$ , trimester 2:  $n = 350$ , trimester 3:  $n = 350$ ), of whom 250 also completed postpartum assessment. During the pandemic, from 1 March 2020 to 14 May 2020, 268 women filled out at least one questionnaire during

pregnancy (trimester 1:  $n = 265$ , trimester 2:  $n = 203$ , trimester 3:  $n = 110$ ), and 59 completed postpartum assessment. This resulted in data of 669 participants to be analyzed in the current study. Because the pandemic period was defined as the 3-month nationwide strict lockdown, this study period ended before all women had completed assessment in the third trimester of pregnancy or postpartum. During pregnancy 436 completed all questionnaires, 131 completed two questionnaires and 102 completed one questionnaire.

These participating women had a mean age of 30.83 ( $SD = 3.66$ ), 66.6% was highly educated (Bachelor's degree or higher), and 97.4% had a Dutch ethnic background. The majority of women were employed (94.8%), of which only 4 (0.6%) indicated they would not return to work after maternity leave. Of the 669 participating women, 98.8% had a partner, of which 98.9 were in a heterosexual relationship. The majority of the partners were employed (99.4%). Furthermore, 316 (48.2%) women were primiparous, 164 (24.8%) women had a previous miscarriage or abortion, 48 (7.3%) women had an unplanned pregnancy, and 77 (11.5%) women had a previous diagnosis of depression. Table 1 shows the demographic characteristics of the women who were pregnant before and during the COVID-19 pandemic. The demographic characteristics between the pandemic and pre-pandemic group were similar with regard to age, education, employment, marital status, parity, unplanned pregnancy, previous miscarriage, previous diagnosis of depression, and BMI.

**Table 1.** Demographic characteristics of women who were pregnant before and during the COVID-19 pandemic (N = 669).

Pregnancy (N = 669) Demographics	Pre-pandemic group (n = 401)				Pandemic group (n = 268)			
	N	%	Mean (SD)	Range	N	%	Mean (SD)	Range
Age	395		30.88 (3.67)	21-41	265		30.75 (3.64)	19-45
High education	255	64.6			184	69.7		
Employment	372	94.7			252	95.1		
Having a partner	380	98.4			260	99.2		
Primiparous	177	45.4			139	52.5		
Unplanned pregnancy	24	6.1			24	9.1		
Previous miscarriage	96	24.3			68	25.7		
Previous diagnosis of depression	36	11.6			41	15.5		
BMI	391		24.01 (4.07)	17-42	265		24.08 (3.65)	18-37

Note. The pandemic group completed at least one questionnaire between 1 March 2020 and 14 May 2020. High Education, Bachelor's degree or higher; BMI, Body Mass Index; SD, Standard Deviation

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

## Measures

### *Depressive symptoms*

The 10-item Edinburgh (Postnatal) Depression Scale (E(P)DS) was used to measure depressive symptoms during pregnancy and postpartum<sup>12</sup>. The E(P)DS is a frequently used and widely applicable instrument for perinatal use<sup>13</sup>. Items were rated on a 4-point Likert-type scale. Total scores range between 0-30, with higher total scores indicating higher levels of depressive symptoms. A score higher than 12 was used to identify the women at risk for high levels of postpartum depressive symptoms<sup>12</sup>. The Cronbach's alpha of the E(P)DS varied between  $\alpha = 0.85$  and  $\alpha = 0.86$  in the current study.

### *Pregnancy-specific stress*

We assessed pregnancy-specific stress using the 10-item adapted version of the negative affect subscale of the Tilburg Pregnancy Distress Scale (TPDS-NA). The scale assesses worries during pregnancy about fetal health, childbirth and delivery<sup>14</sup>. Examples of items are "I worry about the pregnancy" and "I get very tense hearing stories about deliveries". Items were rated on a 4-point Likert-type scale (0 = very

*often, 1 = fairly often, 2 = now and then, 3 = rarely or never*). Total scores range from 0-30, with higher total scores indicate higher levels of pregnancy-specific stress. The TPDS showed good psychometric properties regarding internal consistency, test-retest reliability, hypotheses testing and concurrent validity<sup>14</sup> and has been reviewed as excellent in terms of its internal consistency and structural validity<sup>15</sup>. Since its development, the TPDS has been translated into various languages such as, amongst others, English, Portuguese, Turkish, Spanish, Mandarin and Japanese. The TPDS-NA has been shown to correlate significantly with the E(P)DS at all trimesters of pregnancy (range  $r = 0.50 - 0.54$ , all  $p < 0.001$ )<sup>14</sup> and with the Generalized Anxiety Disorder - 7 ( $r = 0.52$ ,  $p < 0.001$ )<sup>16</sup>. The Cronbach's alpha ranged from  $\alpha = 0.80$  to  $\alpha = 0.86$  for the TPDS-NA in the current study.

### Statistical analyses

Mixed models statistics were used to analyze the possible effect of the pandemic on the individual trajectory of depression and stress symptoms over time (different trimesters of pregnancy). We selected covariates based on theory (age, education, employment, marital status, parity, unplanned pregnancy, previous miscarriage and previous diagnosis of depression) (for review see Biaggi et al.<sup>17</sup>). For mixed model analyses, all cases can be included, including those that do not have measurements for every point in time<sup>18</sup>. Therefore, all participants that completed at least one assessment during pregnancy were included in the analyses. As an assistance to the interpretation of results, the significant coefficients in terms of percentage change in symptoms per unit change [formula:  $(\exp B-1)*100$ ] were reported. Next, logistic regression analysis was used to examine whether perinatal pandemic women were more likely (OR, 95%CI) to develop high levels of postpartum depressive symptoms than pre-pandemic women, using the predefined postpartum cut-off ( $> 12$ ) for the E(P)DS.

### Results

The Pearson  $r$  correlations between the E(P)DS and the TPDS-NA were  $r = 0.49$  at trimester 1,  $r = 0.50$  at trimester 2 and  $r = 0.56$  at trimester 3 (all  $p < 0.001$ ).

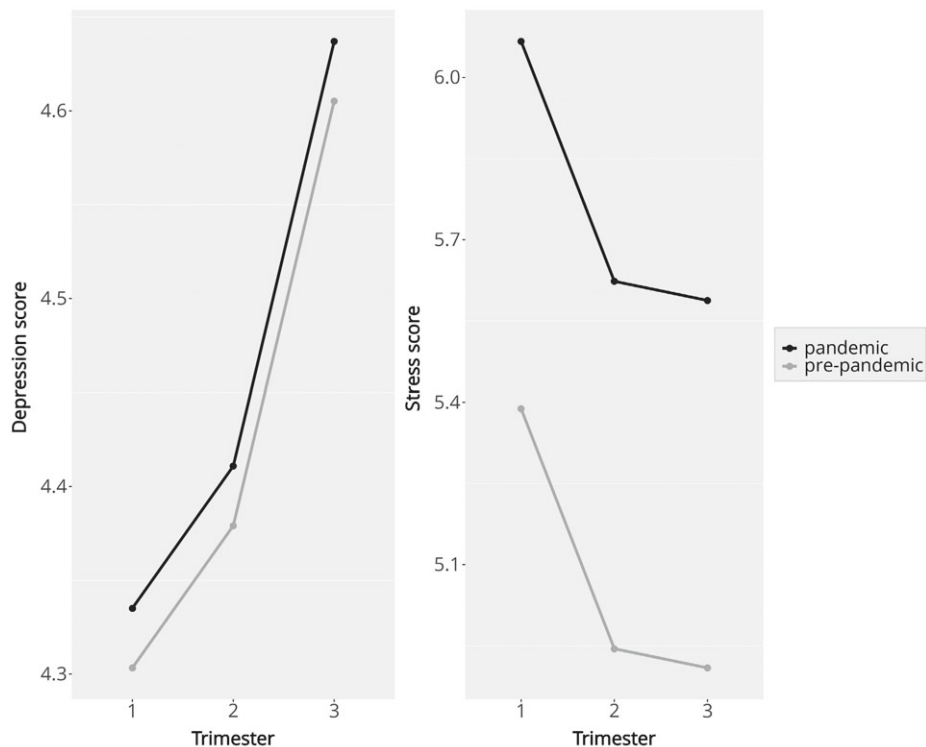
For the pre-pandemic group, the median score on the E(P)DS was 4 (IQR = 6) in the first trimester, 4 (IQR = 5) in the second trimester and 4 (IQR = 7) in the third



trimester. For the pandemic group, the median score on the E(P)DS was 4 (IQR = 5) in the first trimester, 4 (IQR = 6) in the second trimester and 5.5 (IQR = 6) in the third trimester. With regard to the TPDS-NA, the pre-pandemic group had a median score of 4 (IQR = 4) in the first trimester, 4 (IQR = 5) in the second trimester and 3 (IQR = 6) in the third trimester. The pandemic group had a median TPDS-NA score of 5 (IQR = 5) in the first trimester, 4 (IQR = 6) in the second trimester and 4 (IQR = 7) in the third trimester.

Results of mixed model analyses showed that for the E(P)DS-model, the main effect of the pandemic was not a significant predictor of depressive symptoms throughout pregnancy ( $B = -0.03$ ,  $SE = 0.32$ ,  $t = -0.09$ ,  $p = 0.925$ ). The results of the current study showed that there was a slight increase in depressive symptoms from trimester 1 to trimester 3, but this effect of time was not significant ( $F(2, 881.14) = 1.21$ ,  $p = 0.300$ ).

However, the TPDS-NA-model showed a main effect of pandemic ( $B = -0.69$ ,  $SE = 0.32$ ,  $t = -2.13$ ,  $p = 0.034$ ) on pregnancy-specific stress symptoms. The unstandardized beta coefficient can be explained as the percentage change in stress per unit change in the pandemic group, corresponding to 49.7% higher stress scores in the pandemic group. The effect of time on stress during pregnancy was significant ( $F(2, 870.46) = 5.87$ ,  $p = 0.003$ ), showing a decrease over time. Compared with trimester 3, there was a significant difference in stress scores for trimester 1 ( $B = 0.48$ ,  $SE = 0.17$ ,  $t = 2.88$ ,  $p = 0.004$ ) but not trimester 2 ( $B = 0.04$ ,  $SE = 0.17$ ,  $t = 0.23$ ,  $p = 0.824$ ). Figure 2 provides a graphical overview of the results.



**Figure 2.** Mean depression and stress symptom scores during gestation for women who were pregnant pre-pandemic (grey line) compared to those pregnant during the pandemic (black line). There were no differences in depression scores but women who were pregnant during the pandemic had significantly higher stress scores compared to non-pandemic women.

*Note.* The axes have a different range for the E(P)DS and TPDS; the pandemic group completed at least one questionnaire between 1 March 2020 and 14 May 2020. Depression score pre-pandemic:  $n = 393$  at T1,  $n = 350$  at T2, and  $n = 350$  at T3; Depression score pandemic:  $n = 265$  at T1,  $n = 203$  at T2, and  $n = 110$  at T3. Stress score pre-pandemic:  $n = 312$  at T1,  $n = 313$  at T2 and  $n = 330$  at T3; Stress score pandemic:  $n = 265$  at T1,  $n = 203$  at T2 and  $n = 111$  at T3.

Seven percent of the pre-pandemic and 8.5% of the pandemic women had a score higher than 12 on the E(P)DS at 8-10 weeks postpartum, which may suggest high levels of postpartum depressive symptoms. Belonging to the pandemic group was not related to high levels of postpartum depressive symptoms (OR = 1.24, 95%CI: 0.44 - 3.50),  $p = 0.689$ ).

## Discussion

Stress symptoms increased significantly in pregnancy during the COVID-19 outbreak. Interestingly, we did not see a rise in depressive symptoms during pregnancy nor an increase in incidence in high levels of postpartum depressive symptoms during the pandemic. Although studies have shown that there is an association between prenatal symptoms of anxiety and postpartum depressive symptoms<sup>19</sup>, the presence of COVID-19-related worries and anxiety during pregnancy might be unrelated to postpartum depression. It could be that after childbirth has passed, which is a potential stressful event during the COVID-19 pandemic, COVID-19-related anxiety decreases, especially when the newborn is healthy.

Our findings could be of clinical importance, especially if replicated in populations with lower education and single parent households, as well as in other countries. Our results indicate that many pregnant women may suffer from stress during the COVID-19 outbreak, but these symptoms may not be detected during routine screening. The E(P)DS is a widely used screening instrument to assess depressive symptoms during pregnancy<sup>13</sup>, but does not measure pregnancy- and delivery-related worries and anxiety. While we fully support the E(P)DS as screening instrument during pregnancy to detect increased depressive symptoms, the use of the E(P)DS may not be sensitive enough to detect COVID-19-induced stress in pregnant women and could lead to underestimation of the mental health burden. Ideally, clinicians could consider adding screening instruments for stress symptoms, especially during the COVID-19 outbreak. The TPDS-NA is appropriate for the assessment of pregnancy-specific worries and stress but adjusted scales to assess COVID-19-related stress may be even more appropriate for this population (e.g., Taylor et al.<sup>20</sup>). In addition, future studies should assess COVID-19-related stress and worries specific to perinatal women.

Moreover, the complexity of appropriate and effective mental health treatment for mothers during the pandemic should be further examined in future studies, especially a comparison between effectiveness of face-to-face treatment and customized treatment to the pandemic (e.g., virtual). In their meta-synthesis, Shorey and Chan<sup>21</sup> drew on experiences from past epidemics and pandemics, concluding a need for technology-based interventions and psychosocial interventions for mental health

care in pregnant women. An example could be an online mindfulness intervention, that have shown to reduce levels of distress<sup>22</sup>, but future studies should assess its effectiveness in pregnant women<sup>23</sup>.

### **Strengths and limitations**

The current study has a number of strengths and limitations that should be mentioned. A key strength of this study is the longitudinal design of our cohort, which allowed us to measure symptoms of stress and depression during the course of pregnancy, as well as to compare symptoms before and during the pandemic. Nevertheless, the following limitations should also be considered. First, the sample that was assessed in the current study consisted solely of Dutch women. This may limit generalizability of results to other countries with different cultures, health care systems and standard of living. Additionally, the participants were predominantly (66.6%) highly educated. This rate is higher compared to the general female population in the Netherlands with a similar age category, where approximately 48-56% was highly educated between 2019 and 2020<sup>24</sup>. Furthermore, participants in the current study more often had a partner compared to the general Dutch population. It has been shown that 8.8% of the children born in 2019 in the Netherlands were born in a single-parent household<sup>25</sup>. Therefore, generalization of our results could be restricted. Furthermore, even though the longitudinal design of the current study allowed us to assess the course of symptoms during pregnancy, the current design did not allow for an assessment of change in symptoms of depression and stress from the prenatal to postnatal period, nor a comparison in this change between the pandemic and pre-pandemic group.

As the pandemic progresses, future studies should be able to address the longitudinal effects of the COVID-19 pandemic on depressive and stress symptoms (from pregnancy to postpartum and early parenthood). Another limitation of the study is the smaller sample size for the postpartum assessment of the pandemic group ( $n = 59$ ) compared to the pre-pandemic group ( $n = 250$ ), suggesting careful interpretation of postpartum results. Finally, we assessed high levels of depressive symptoms with a self-report instrument, the E(P)DS, and not with a diagnostic interview. However, based on their review, O'Connor et al.<sup>13</sup> concluded that the E(P)DS is a frequently used and widely applicable screening instrument, and found that the sensitivity of the E(P)DS ranged between 0.67 and 1.00 and specificity was higher than 0.87 in the included studies.

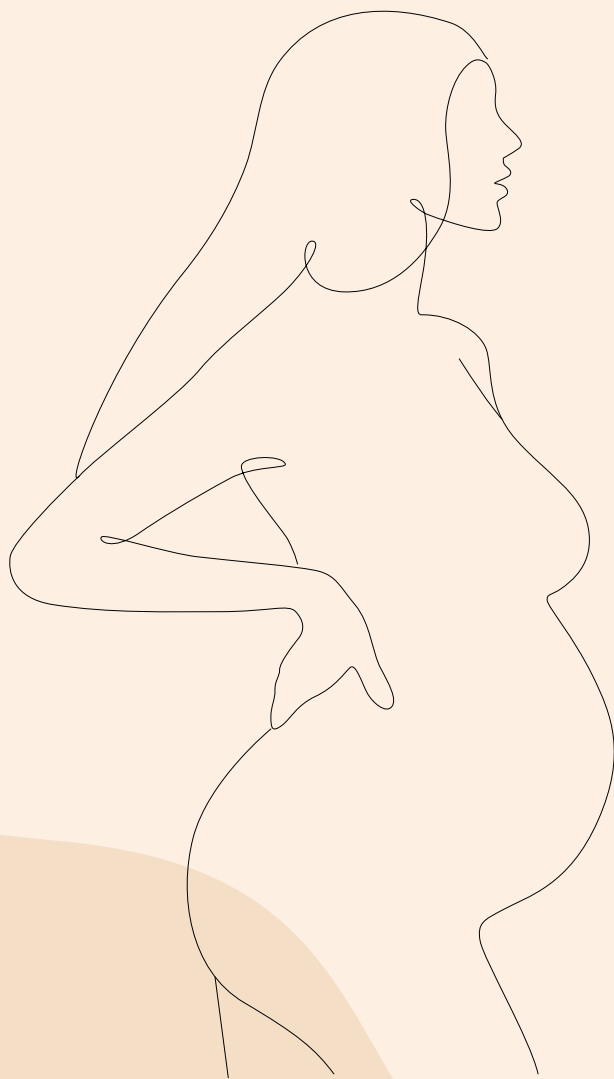
**Conclusions**

Our findings indicated that the COVID-19 pandemic induces worries in pregnant women in the Netherlands. Given that fetal exposure to stress can have detrimental effects on child brain development<sup>26</sup>, we conclude that it is important for clinicians to be extra aware of pregnant women with increased levels of stress during the COVID-19 pandemic. It is of great importance that adequate mental health care and support is provided for mothers in need<sup>27</sup>.

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# Chapter 7

**General discussion**

Pregnancy is an important and impactful life event. There are numerous ways to make the experiences of this life event as positive as possible. There are also challenges that can be burdensome or even stressful during the perinatal period, including those related to physical, psychological, and social changes. Many of these changes have been shown to be associated with increased levels of psychological distress<sup>1-5</sup>. Several risk factors for psychological distress during the perinatal period have already been identified<sup>6-12</sup>. However, as the world is changing fast, new risk factors might also emerge. Therefore, the main aim of this thesis was to explore important novel risk factors for maternal mental health problems during the perinatal period. In **Chapter 2**, unplanned pregnancy was investigated as a possible risk factor, **Chapter 3** to **5** explored the role of social media use, and in **Chapter 6** the possible effect of the COVID-19 pandemic on mental health was investigated.

This General Discussion is organized in five sections. **Section 1** of the General Discussion provides an overview of the main findings of this thesis. In **Section 2** the methodological considerations of the chapters are presented. The strengths and limitations of this thesis are discussed in **Section 3**. The implications for future research and relevance for clinical practice are described in **Section 4**. **Section 5** will discuss the general conclusions.

## **Section 1 – Overview of the main findings**

### **1.1 Unplanned pregnancy**

In **Chapter 2** of this thesis, it was examined whether there is an association between unplanned pregnancy and depressive symptoms during the perinatal period, from early pregnancy until 12 months postpartum. While previous studies explored this association, there is a gap in research that investigates this association longitudinally across the entire perinatal period. Additionally, it is crucial to examine this association within the Dutch population, given the differences in obstetric care in the Netherlands compared to other countries. Therefore, the association between unplanned pregnancy and depressive symptoms was assessed in the Dutch, large longitudinal cohort study, the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study<sup>13</sup>. Chapter 2 reported a prevalence of 5.8% of unplanned pregnancies in the sample of 1928 women, which is in line with the national figures of the Netherlands at that time<sup>14</sup>. Depressive symptoms were measured three times

during pregnancy; at 12, 22 and 32 weeks gestation, and five times postpartum; 1 week, 6 weeks, 4 months, 8 months, and 12 months. Data were analyzed using an advanced statistical method, namely linear mixed model analyses. Linear mixed model analyses are robust against missing data, meaning that incomplete datasets can be included in the model<sup>15</sup>. Results of the study indicated that women who reported their pregnancy to be unplanned, scored consistently higher on depressive symptoms in all trimesters of pregnancy and during the entire postpartum period. However, the course of depressive symptom scores over time was the same for both women with an unplanned and a planned pregnancy. Chapter 2 also revealed that lower age, unemployment, and a history of depression were related to higher levels of depressive symptoms. Finally, we performed a sensitivity analysis, repeating the linear mixed model analysis only with women who did not report a history of depression. This sensitivity analysis showed similar results.

## 1.2 Social media use

Utilizing social media during pregnancy can be very useful for many women, since it can help them to cope with the various physical, psychological, and social changes that accompany this period. While social media can offer emotional and social support<sup>16-18</sup> to pregnant women, there is limited understanding of its potential adverse effects on mental health. Therefore, this thesis assessed the impact of social media use during pregnancy on mental well-being, using data of the large longitudinal cohort study the Brabant Study<sup>19</sup>.

**Chapter 3** described the associations of social media use with trajectories of depressive symptoms throughout pregnancy. By using growth mixture modeling (GMM), a three-class model was found, representing three different groups of women with similar patterns of depressive symptoms during the course of pregnancy. The first class, a low stable class, was considered as the reference category and contained 70.2% of the women in the sample. This class represented the women with persistently low depression scores throughout the course of pregnancy. Secondly, an intermediate stable class, which contained 26.3% of women in the sample. This class contained women with persistent intermediate depression scores over the course of pregnancy. And lastly, a high stable class, which contained 3.6% of women in the sample and represented women with persistently high depression scores over the course of pregnancy. The results showed that both the time spent on social

media and frequency of social media use were significantly associated with higher odds of belonging to the high stable class compared to the odds of belonging to the low stable class. Furthermore, higher scores on social media addiction, using the Bergen Social Media Addiction Scale (BSMAS), were significantly associated with higher odds of belonging to both the intermediate stable and the high stable class. Importantly, additional subgroup analyses, excluding women with a previous history of depression, which was the only significant predictor of all covariates, showed similar results. This implies that the association between maternal depressive symptoms during pregnancy and social media use was not limited to participants with a history of depression. Taken together, this study found that more intense and more problematic social media use during pregnancy was associated with higher levels of depressive symptoms, even when accounting for a history of depression. Interestingly, the study reported that 6.3% of pregnant women were potentially addicted to social media, based on a BSMAS cut-off score<sup>20</sup>. When examining the distribution of the BSMAS cut-off scores stratified according to the established trajectories of depressive symptoms during pregnancy, we found that 3.3% of women of the reference category (the low stable class) scored above the cut-off of problematic social media use, 9.8% of the intermediate stable class and 40% of the high stable class. This distribution corroborates the findings, by demonstrating an association between problematic social media use and persistently high levels of depressive symptoms during pregnancy.

In **Chapter 4**, the longitudinal course of social media use throughout pregnancy was investigated. The results of this study showed that there was a significant change in social media use over time for all three types of social media use: the time spent on social media, frequency of social media use and problematic social media use. For all three social media variables, a similar pattern of change was found: lowest levels in the first trimester of pregnancy, (significantly) increased levels at 20 weeks of pregnancy, and stabilization at 28 weeks of pregnancy. Additionally, it was found that primiparous women, in comparison to multiparous women, spent more time on social media in the second trimester of pregnancy. Furthermore, 10.5% of the women scored above the suggested cut-off of the BSMAS<sup>20</sup>, defining problematic use, at least once during pregnancy, and thus were potentially addicted to social media. At 12 weeks of pregnancy, 5.2% of women scored above the cut-off of the BSMAS, at 20 weeks 7.0% and at 28 weeks of pregnancy 5.7%.

Building on the observed association between suboptimal social media use with depressive symptoms (Chapter 3), **Chapter 5** used a qualitative methodology to explore relevant factors that might play a role in the interplay of social media use and mental wellbeing during pregnancy. Findings of this study provide a comprehensive understanding of the motives of women for using social media during pregnancy, factors that play a role in possible changes in social media use, as well as the beneficial and adverse effects they might encounter during pregnancy. The qualitative design involved individual in-depth semi-structured interviews with women with self-reported high social media use, selected from the larger cohort. The results of the interviews revealed three main themes: 1) *content consumed during pregnancy*, 2) *motives for social media use during pregnancy* and 3) *consequences of social media use during pregnancy*. The third main theme consisted of three subthemes: *consequences of comparison to others*, *consequences of using social media as an information source*, and *negative feelings as a direct consequence of social media use*. The self-report data showed that women used social media mostly for passing time, maintaining existing relationships, entertainment and for informational and educational purposes.

Taken together, the results of the social media studies in this thesis underscore the importance of social media for pregnant women, but also shed light on its potential negative consequences for the development of prenatal mental health issues over the course of pregnancy.

### 1.3 COVID-19 pandemic

The COVID-19 pandemic has had an enormous impact on society and especially on the mental health of vulnerable groups, such as women in the perinatal period. There were many changes in obstetric care during the pandemic. Additionally, during the pandemic, much time was spent at home, sometimes resulting in strained relationships with the partner<sup>21</sup>. Furthermore, many women experienced job loss due to the pandemic, contributing to potential financial uncertainties<sup>21</sup>. All these pandemic-related changes and difficulties might have had an influence on perinatal mental health. Therefore, in **Chapter 6** of this thesis, the impact of the COVID-19 pandemic on pregnancy-specific distress and depressive symptoms during the perinatal period was investigated. This study was conducted with longitudinal data of the Brabant Study<sup>19</sup>. Before the onset of the COVID-19 pandemic in the Netherlands on March 1, 2020, a total of 401 women participated in the study by completing questionnaires

during different pregnancy trimesters. During the first pandemic period, from March 1, 2020, to May 14, 2020, 268 women participated in the Brabant Study by filling out at least one questionnaire during pregnancy. Linear mixed models were used to analyze the data. The results of the study showed that pregnancy-specific distress symptoms increased significantly during pregnancy during the COVID-19 pandemic. However, no increase of depressive symptoms during pregnancy or of levels of postpartum depressive symptoms were found during the pandemic. Importantly, since the pre-pandemic and pandemic groups did not differ on demographic characteristics regarding age, education, employment, marital status, parity, unplanned pregnancy, previous miscarriage, previous diagnosis of depression and BMI, we can conclude that the observed differences in mental health between these groups are not likely to reflect differences in demographic characteristics.

## Section 2 – Methodological considerations

This section discusses several methodological issues relevant to the research described in this thesis. Specific attention will be given to the assessment and interpretation of unplanned pregnancy, social media use and aspects related to the COVID-19 pandemic relevant to mental wellbeing during the perinatal period. Special emphasis is given to methodological issues related to cross-sectional versus longitudinal studies of psychological factors assessed during pregnancy and after delivery.

### 2.1 Unplanned pregnancy

#### 2.1.1 Operationalization of the concept of unplanned pregnancy

In this thesis, unplanned pregnancy was measured by a single question, namely, “is the current pregnancy planned?” Women could answer this question with “yes” or “no”. **Chapter 2** showed a prevalence of 5.8% of unplanned pregnancy in the sample. Compared to other countries, such as the USA (45% unintended)<sup>22</sup> and UK (16.2% unplanned, 29.0% ambivalent)<sup>23</sup>, the percentage of unplanned pregnancy is relatively low in the Netherlands. One of the reasons for this lower percentage might be that most women seeking an abortion in the Netherlands, because of an unplanned *and* unwanted pregnancy, typically find their way to a clinic where they can receive care as needed, even without a referral from a general practitioner, within the first 8 to 10 weeks of gestation. For this study, community midwives

enrolled all participants between 8 to 12 weeks of gestation, therefore, it is likely that most women with an unplanned *and* unwanted pregnancy already made the decision for an abortion before they decided to make a first antenatal appointment with the community midwife. This perspective is supported by the results of one of our previous longitudinal birth cohort studies<sup>24</sup>, performed in the same area with identical demographic characteristics as in the HAPPY study, where the concept was defined as: pregnancy was 1) planned, 2) unplanned but *not* unwanted, 3) unplanned *and* unwanted. In this previous study, 7.9% of pregnancies were unplanned. Of these unplanned pregnancies, only two (0.16% of the total group) were *not* wanted. Therefore, because of this small percentage, in the present study we decided to focus on the concept of “unplanned pregnancies” only, and it is reasonable to assume that these unplanned pregnancies indeed were unplanned but *not* unwanted. In addition, over the years, the number of abortions in the Netherlands has increased, with a 15% rise between 2021 (28.089) and 2022 (32.348)<sup>25</sup>. These terminated pregnancies can be characterized as unplanned *and* unwanted. Given this essential background information, it is even more noteworthy that an unplanned pregnancy – even when it is *unplanned but not unwanted* – has a long-lasting adverse impact on a woman’s perinatal mental health, as shown in this thesis.

Our findings are difficult to compare with data from the literature, since there is inconsistency regarding the precise definition of an unplanned pregnancy. The terms unplanned, unintended, mistimed, and unwanted pregnancy are often used interchangeably, despite crucial distinctions between these concepts<sup>26,27</sup>. For example, a significant difference exists between pregnancies that occur two or more years earlier than desired (mistimed) and pregnancies that are not wanted at all (unwanted). Further research is needed to elucidate these differences in definition. Barrett et al.<sup>28</sup> have made an attempt to clarify the confusion by developing the London Measure of Unplanned Pregnancy. The creators of the questionnaire highlighted the complexity of the concept of unplanned pregnancy. In their questionnaire, for example, they took factors such as contraception use and pregnancy intention prior to conception into account, which are definitely important dimensions to consider when investigating pregnancy planning. However, upon closer examination of the development paper of the scale, it became evident that a confirmatory factor analysis was not conducted. Furthermore, several inter-item correlations exceeded 0.80,

indicating that these items likely measure similar facets of the concept unplanned pregnancy, which also could easily lead to a high Cronbach's alpha.

Furthermore, Barton et al.<sup>29</sup> showed that women with unplanned pregnancies with negative or ambivalent emotions toward their situation showed elevated levels of psychological distress compared to those with positive feelings about their unplanned pregnancies. Given the persistently negative impact of an unplanned pregnancy on depressive symptoms up to 12 months postpartum, as shown in this thesis, there is an urgent need of developing a new instrument measuring the concept of unplanned pregnancy, in which the negative and positive emotional aspects will be taken into account.

### ***2.1.2 Cross-sectional versus longitudinal analyses***

The association between unplanned pregnancy and depressive symptoms in the perinatal period, has been described in previous studies as summarized in a systematic review and meta-analysis by Abajobir et al.<sup>30</sup>. However, most of these studies used a cross-sectional study design or assessed only two time points, for instance, only once during pregnancy and once postpartum. Because perinatal depressive symptoms are variable over time<sup>31-33</sup>, both between individuals but also within individuals over time<sup>31-34</sup>, we assessed depressive symptoms longitudinally over the course of pregnancy up to 12 months postpartum using linear mixed model analysis. When assessing depressive symptoms in relation to unplanned pregnancies cross-sectionally 'between' individuals, crucial information might be missed, resulting in mixed and conflicting outcomes. Cross-sectional assessments namely represent symptom levels at a specific moment, thereby lacking the ability to consider the variability in symptoms over time, which could be demonstrated with the cross-sectional study of Abbasi et al.<sup>35</sup>. It was investigated whether pregnancy intention was associated with the prevalence of postpartum depression at one month postpartum in first-time mothers, controlling for various pregnancy characteristics. The results of this study showed that unintended pregnancy was not independently associated with postpartum depression. The conclusion of this study might have been different when data were collected and assessed longitudinally, as we did in our study. In our study we assessed depressive symptoms longitudinally in each trimester of pregnancy (12, 22, and 32 weeks) and postpartum (1 week, 6 weeks, 4 months, 8 months, and 12 months). The results of our study showed an association



between unplanned pregnancy and depressive symptoms during pregnancy. It is plausible that if Abbasi et al.<sup>35</sup> had also used a longitudinal approach to explore this association, their findings might have aligned with our conclusion, that an unplanned pregnancy has an impact on the mental health of perinatal women.

## 2.2 Social media use

**Chapters 3, 4, and 5** focus on social media use during pregnancy. The following paragraphs address issues related to operationalization and the relevance of the study design in this area of research.

### 2.2.1 Operationalization of the concept social media use

Our study is among the first to investigate the association between intensity of prenatal social media use and problematic social media use with depressive symptoms during pregnancy. The conceptualization of social media use during pregnancy in this study is unique, assessing three different social media variables: the time spent on social media, the frequency of social media use and problematic social media use (social media addiction). The results of this study are in line with previous studies that found an association between problematic social media use and mental health problems in the general population<sup>36-38</sup>, although not all studies found an association with intensity of social media use.

A possible explanation why this study did find an association between intensity of social media use and depressive symptoms during pregnancy, could be that pregnant women who use more social media are more prone to mental health issues than the general population. This can potentially be explained by the *motherhood constellation theory*<sup>39</sup>. During pregnancy, women develop a new mental organization in which the baby is the most important. The interests of the pregnant women shift more towards pregnancy-related topics, including the baby and motherhood. This can be very helpful to pregnant women, but it can also induce more stress. It could therefore be that pregnant women use social media for other reasons than non-pregnant women. For instance, non-pregnant young adults might use social media more often for entertainment reasons instead of information<sup>40</sup>. Furthermore, this theory might also explain the relatively high percentage of problematic social media use among pregnant women in the current thesis: between 6.3% and 10.5%. Among Dutch adolescents in 2020, this percentage was only 3.2%<sup>37</sup>. Because the baby is

entirely dependent on the mother, pregnant women might rely extensively on social media for pregnancy-related information.

In this thesis, we have used the Bergen Social Media Addiction Scale (BSMAS) to measure problematic social media during pregnancy<sup>41</sup>. This scale is an adaptation of the Bergen Facebook Addiction Scale<sup>20</sup>. In this new scale the word 'Facebook' has been replaced by 'social media', to assess problematic social media use in general. Each item of the BSMAS reflects a core element of addiction; salience, mood modification, tolerance, withdrawal, conflict, and relapse<sup>42</sup>. The original scale was initially developed with a pool of 18 items, three items per core element of addiction. Students filled out these items, together with several other self-report scales. The items within each of the elements with the highest corrected item-total correlations were selected for the final scale. The initial 18 items were formulated and chosen by researchers. It would have been better to construct such a scale using in-depth focus group interviews, to make sure the items really reflect social media addiction issues and are relevant to the target group.

One of the main aims of **Chapter 5** was to gain a more comprehensive understanding of the motives of women for utilizing social media during pregnancy. Several previous studies also investigated for what purposes pregnant women use social media. However, these studies often researched specific motivations instead of investigating it with an open question (e.g., Gleeson et al.<sup>43</sup>; Lee & Lee<sup>44</sup>; Lupton<sup>45</sup>). To our knowledge, this study is the first to assess the motives of pregnant women to use social media during pregnancy *and* its possible negative and positive consequences, evaluating eleven individual in-depth semi-structured interviews. Participants were included into the study until data saturation was reached, which means that the study has gathered a sufficient amount of data to draw conclusions, and additional data collection would not have yield additional valuable insights.

Research has already found an association between the use of social media and experiencing negative feelings<sup>18,46</sup>. However, the direction of this association remains unclear: are negative feelings leading to more social media use or is social media use leading to more negative feelings (or both)? The interviews in this study showed that women primarily experienced negative feelings as a consequence of social media use, rather than the other way around. The interviews thus gave an important insight

into the direction of the association. Still, this finding should be further investigated by quantitative studies in which a social media use questionnaire is administered before pregnancy (or even before women decide to stop contraception) and several times during pregnancy, in a large sample of pregnant women. Furthermore, large samples would enable to examine primiparous and multiparous women separately, since the results of this thesis showed some evidence that primiparous women spend more time on social media during pregnancy.

### **2.2.2 Cross-sectional versus longitudinal analyses**

As mentioned earlier in this chapter, perinatal depressive symptoms are variable over time<sup>31-33</sup>, therefore it is important to assess these perinatal depressive symptoms longitudinally instead of cross-sectionally. Furthermore, in **Chapter 4** it was shown that there was a significant change in social media use over time for the time spent on social media, frequency of social media use and problematic social media use. Social media usage was at its lowest at 12 weeks of pregnancy and increased significantly at 20 weeks of pregnancy. Subsequently, it maintained at a stable level at 28 weeks of pregnancy. Furthermore, at 12 weeks of pregnancy, 59 women (5.2%) scored above the cut-off of the BSMAS, at 20 weeks 80 women (7.0%) and at 28 weeks of pregnancy 65 women (5.7%). These results also indicate the importance of future longitudinal research, instead of cross-sectional research, in relation to social media use during pregnancy.

## **2.3 COVID-19 pandemic**

This thesis project was conducted during the unique time frame of the COVID-19 pandemic. The pandemic had a major impact on mental and physical wellbeing and the present thesis addresses psychological issues of pregnant women during the COVID-19 pandemic relative to pre-COVID assessment periods.

### **2.3.1 Operationalization of the concept of psychological distress during the COVID-19 pandemic**

Pregnancy-specific distress was measured using the adapted version of the negative affect subscale of the Tilburg Pregnancy Distress Scale (TPDS-NA), including the two subcomponents pregnancy and childbirth<sup>47,48</sup>. Notably, the postpartum subcomponent was excluded in the adapted version. The initial TPDS was developed through focus group interviews involving pregnant women, women who recently gave birth, and

healthcare professionals. Both the original and adapted TPDS comprise two subscales. However, in the adapted version, the first subscale, measuring negative affect, has ten items instead of the original eleven, while the second subscale, assessing partner involvement, consists of four items instead of the initial five. The TPDS is a widely used instrument and has received positive feedback in a review of self-report instruments to identify anxiety during pregnancy<sup>49</sup>, but the scale also has several shortcomings. Analyses of the TPDS across diverse cultural populations revealed that the psychometric characteristics of the TPDS-NA items concerning worries related to childbirth and pregnancy remained consistent across various studies<sup>47</sup>. However, results for postpartum items, specifically those related to concerns about employment and body weight, exhibited more variable factor loadings among different samples<sup>47</sup>. Furthermore, in the HAPPY study, about 2000 pregnant women were asked to provide feedback on the study questionnaires<sup>13</sup>. They gave suggestions to measure pregnancy-specific distress more accurately. Therefore, the adapted version of the TPDS was created, which was used in this thesis. This scale shows adequate psychometrics properties regarding factor structure, internal consistency, test-retest reliability, concurrent validity, and construct validity<sup>47</sup>.

Depressive symptoms were measured using the Edinburgh (Postnatal) Depression Scale (E(P)DS)<sup>50-52</sup> which is not a pregnancy-specific scale and can also be used to measure depressive symptoms in other populations. This might explain why we did not find an association between the COVID-19 pandemic and depressive symptoms in this thesis. Another reason for the lack of increased depressive symptoms during the COVID-19 pandemic in postpartum women, as compared to increased pregnancy-specific distress levels, could be the uncertainty aspect of the (early) COVID-19 pandemic. The COVID-19 pandemic was a very specific situation during which both the mother and the fetus were at high risk of being infected by the virus. Little was known about the possible negative effects of such an infection. Therefore, in this specific situation, scores on the pregnancy-related TPDS-NA might have been higher in comparison to the more general questions of the E(P)DS, because during the COVID-19 pandemic pregnant women were mainly focused on the health of the mother and the fetus.

### ***2.3.2 Cross-sectional versus longitudinal analyses***

The longitudinal design of the Brabant Study allowed us to measure symptoms of pregnancy-specific distress and depression during the course of pregnancy and postpartum and compare symptoms before and during the COVID-19 pandemic. We decided to analyze these data using linear mixed model analyses, meaning all cases were included in the analyses<sup>15</sup>. The first cases of the coronavirus were identified in December 2019 and in March 2020 the outbreak was officially classified as a pandemic. Although research on the impact of the COVID-19 pandemic on the perinatal mental health of women was sparse at the beginning of the pandemic, some studies were conducted<sup>21,53-57</sup>. However, these studies have methodological shortcomings, such as the use of cross-sectional data, retrospective measurements and having no matching control group, or a matching control group from years ago. With the data of the longitudinal prospective cohort study, the Brabant Study, we were able to fill this gap in the literature since data collection started in 2019 and continued during the COVID-19 pandemic. Women who participated in the study completed online questionnaires at 12, 20, and 28 weeks of pregnancy and 8 to 10 weeks postpartum. Before the onset of the COVID-19 pandemic 401 women were included in the study, and during the first pandemic period 268 women participated. With the data of the study, we were able to compare symptoms of depression and pregnancy-specific distress in the perinatal period during and right before the COVID-19 pandemic. Results of this study showed that pregnancy-specific distress increased significantly in women during the pandemic, however, no increases in depressive symptoms during pregnancy and the postpartum period were found.

## **Section 3 – Strengths and limitations**

The data of both the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study<sup>13</sup> and the Brabant Study (BrSt)<sup>19</sup> were used in this thesis. In this section of the General Discussion, the strengths and limitations of those two longitudinal prospective cohort studies will be discussed as well as study-specific limitations.

### **3.1 Strengths**

First, the large sample size of women followed during pregnancy and postpartum is a key strength of both the HAPPY study and the BrSt. Another major strength of both studies is the longitudinal design, with multiple assessments during pregnancy and

postpartum. The longitudinal assessments of pregnancy-specific distress and perinatal depressive symptoms, enabled us to investigate the course of these symptoms over time, using multivariable statistical methods. Another strength of this thesis is that the participants were recruited by the community midwives in the South-East of the Netherlands and that the response rates were relatively high, 72% in the HAPPY study and 63% in the BrSt. The lower response rate of the BrSt can be largely attributed to the COVID-19 pandemic. During the pandemic, women were more reluctant to participate in the BrSt because it also meant they had to have blood drawn more often, which could increase the risk of infection as it meant they would have more contact with other people. However, these percentages are similar or even higher compared to the response rates of other population based epidemiological studies, conducted before the pandemic started, such as the Generation R study, which is a population-based prospective cohort study from fetal life until adulthood<sup>58</sup>. The Generation R study reported a response rate at baseline of 61%<sup>58</sup>. The fact that community midwives recruited the participants and that the response rates were relatively high, suggests that both samples adequately represent the general pregnant population in the South-East of the Netherlands. This was confirmed in terms of the obstetric characteristic of the study samples, such as age at first birth, parity, mode of delivery, and number of previous miscarriages, which were similar to the National Dutch birth cohorts of 2014 to 2022<sup>59</sup>. Furthermore, a strength of the current thesis is the use of standardized and validated questionnaires to measure depressive symptoms during the perinatal period (E(P)DS) and pregnancy-specific distress (TPDS). Finally, a strength of the current thesis is the multimethod approach (i.e., both quantitative and qualitative methods) used to investigate possible risk factors for mental health problems during the perinatal period and the use of several multivariable statistical techniques including repeated measures (RM) ANOVA, linear mixed models (LMM), and growth mixture modeling (GMM).

### 3.2 Limitations

One limitation of the current thesis is that most of the participating women were Dutch, white, and highly educated women, which is not in line with the national samples<sup>60</sup>. The high percentage of highly educated women in the current study samples (HAPPY study and BrSt) can easily be explained by the region in the Netherlands in which a large part of the women were recruited, namely the Eindhoven area in the South-East of the Netherlands. The Eindhoven area was labeled as 'smartest region in

the world' in 2011<sup>61</sup>, probably due to the technical university and several high-tech companies being located in the area. Because of these differences between our study samples and the national demographics, the generalizability of the results of this thesis might be limited. Thus, the sample was highly educated compared to the general Dutch population, but it was representative of the area where the studies were conducted, suggesting limited inclusion bias.

Another limitation of this thesis is that the outcome variables, maternal depressive symptoms and pregnancy-specific distress, were measured by self-report. By using self-report measurements to assess depression, depressive symptoms rather than depression as a syndrome is measured. To measure depression as a syndrome, diagnostic psychiatric interviews can be used, such as the Composite International Diagnostic Interview (CIDI) or the Structural Clinical Interview (SCID)<sup>62,63</sup>. However, the large sample sizes in the current thesis precluded assessment of depression using diagnostic interviews. Moreover, there is growing consensus, as summarized in the DSM-5, to assess psychological distress, such as depression, on symptom level instead of using a dichotomous approach<sup>64</sup>.

Furthermore, due to study design we cannot draw definite conclusions about causality. In **Chapter 3**, we investigated social media use as a possible risk factor for depressive symptoms during pregnancy. We concluded that we were unable to estimate how these two variables influence each other, i.e., what the direction of this association is. It could be that women with more intense and problematic social media use are at a higher risk to become depressed, however it could also be that women who are more depressed use social media more often. Future research is needed to address this causality problem, by for example performing cross-lagged panel models to determine the direction of the relationship between social media use and depressive symptoms during pregnancy. In **Chapter 6**, we investigated the relationship between the COVID-19 pandemic and pregnancy-specific distress and depressive symptoms during the perinatal period. There were sub-samples of women who completed the study *before* the COVID-19 pandemic emerged, this enabled us to compare the course and severity of depression and pregnancy-specific distress symptoms with those of women who participated in the study *during* the pandemic.

Because a large part of the participants of the BrSt were recruited during the COVID-19 pandemic, the pandemic might have influenced the outcomes of the social media studies. Increased fear of the corona virus has been related to an increase in searching for information via social media<sup>65</sup>, which might have resulted in higher intensity of social media use and more problematic social media use in the studies of this thesis. Furthermore, several studies reported a negative effect of the COVID-19 pandemic on depressive symptoms in pregnant women<sup>21,53-57,66-68</sup>, while we found no effect of the COVID-19 pandemic on depressive symptoms during pregnancy. However, many of these studies have methodological shortcomings, such as not using a control group.

There are also some *study-specific limitations* which are important to mention. First, as mentioned in **Section 2.1.1**, in **Chapter 2** unplanned pregnancy was measured by a single question. This could be seen as a major limitation of this study, however, as already explained, the choice to ask this question this way was based on previous study outcomes in another birth cohort which was recruited in an identical way as the current study including women from the same area.

In **Chapter 4**, we measured the time spent on social media, the frequency of social media use and problematic social media use, using the Bergen Social Media Addiction Scale, three times during pregnancy, at 12, 20 and 28 weeks of pregnancy. Participants were asked to indicate how much time they currently spent on social media and how frequently they currently used social media. However, the Bergen Social Media Addiction Scale (BSMAS) was developed to measure problematic social media use over the past year<sup>41</sup>. Within the Brabant Study we decided to use the original version of the BSMAS, but in hindsight it would have been better to have asked the participants to answer the questions of the BSMAS as the situation was at the time of answering the questions, for example during the first, second and third trimester, rather than over the past year. This would have given us a better understanding of the change in problematic social media use over the course of pregnancy. Furthermore, we do not have information regarding the social media use of the women in the study prior to their pregnancy. This would also have been very useful, since it would have given us the opportunity to compare the social media use from before pregnancy to during pregnancy.



In **Chapter 5** of the current thesis, individual in-depth semi-structured interviews were conducted with women who reported problematic social media use during pregnancy. Most of these interviews were retrospective interviews with women who recently gave birth reflecting on their experiences during pregnancy. This approach might have influenced the results of this study, as it may have caused recall bias as well as recruitment bias, as we only included women who reported problematic social media use during pregnancy. Women might not have remembered their experiences during pregnancy accurately or they might have omitted details. Their memories might have been influenced by subsequent experiences.

## **Section 4 - Implications for future research and relevance for clinical practice**

The findings described in this thesis can be translated into several implications for future research and relevance for clinical practice. These implications concern the impact and assessment of social media use during pregnancy, screening for distress during the perinatal period, and the overall negative effects of distress during the perinatal period.

### **4.1 Social media use and perinatal depressive symptoms**

The findings of this thesis are particularly relevant with regard to social media use as a new risk factor for depressive symptoms during pregnancy. The Netherlands is one of the most intensive internet user countries in the world. In 2019, 87.4% of individuals aged 12 years and older used social media in the Netherlands<sup>69</sup> and even 96% among people between the ages of 25 and 45 years<sup>69</sup>. Furthermore, in recent decades, there has been a significant rise in levels of depressive symptoms among pregnant women, despite improvements in potential protective and predisposing factors such as employment, higher educational level, and reduced smoking and alcohol use<sup>24</sup>. As suggested by Pop et al.<sup>24</sup>, a plausible explanation for this paradox could be the increasing prevalence of extensive social media use among young adults, including those who are pregnant<sup>24,70</sup>. The results of the current thesis support this suggestion, as **Chapter 3** showed that more intense and more problematic social media use during pregnancy were associated with more depressive symptoms and **Chapter 5** revealed different negative consequences of social media use during

pregnancy. Hence, it is plausible that social media use has emerged as a significant new factor contributing to the development of depressive symptoms during pregnancy.

There is still much debate about whether internet and social media addiction should be considered a distinct 'disorder' or viewed as an exponent of an underlying psychiatric disorder. Although problematic social media use or addiction has not been defined as a specific disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the International Classification of Diseases (ICD-10), or by the World Health Organization (WHO), the American Psychological Association (APA) recognizes the necessity for further research to comprehensively understand the influence of social media on mental health. The current thesis showed that between 6% and 11% of pregnant women is possibly addicted to social media, suggesting that this may become an important health risk. This thesis also emphasizes the potential negative effects of social media use in young (expectant) mothers. In a statement of Jellinek, a leading authority in the Netherlands on matters related to alcohol, drugs, and addiction, it was mentioned that the number of people addicted to internet use, and social media, are expected to rise, partly due to ongoing technological development<sup>71</sup>. It is crucial to acknowledge social media use as a new addiction among young people and, consequently, take into account its negative consequences for pregnant women.

#### **4.2 Development of an assessment tool specifically designed for social media use during pregnancy**

In this thesis, the Bergen Social Media Addiction Scale (BSMAS) was utilized to assess problematic social media use during pregnancy<sup>41</sup>. The items for the scale were formulated and chosen by researchers. A more comprehensive method would entail developing the scale through focus group interviews for greater reliability in reflecting social media addiction issues of the target group. Future research on social media use during pregnancy could also focus on creating a pregnancy-specific social media use scale, comparable to the development of the TPDS. The interviews conducted in **Chapter 6** of this thesis could be the starting point for creating this new scale, based on the found main themes and subthemes. We advise that the scale should not merely focus on social media addiction, but mostly on pregnancy-specific social media issues. For each (sub)theme, we have already created an example item in this General Discussion, to give an idea of this possible new questionnaire on social media

use during pregnancy: Content consumed during pregnancy - *"The content I consume on social media, differs from the content consumed prior to my pregnancy"*, motives for social media use during pregnancy - *"I often use social media to obtain information about my pregnancy"*, consequences of comparison to others - *"During my pregnancy, I often compare myself to other pregnant women on social media"*, consequences of using social media as an information source - *"I feel guilty when I do not follow certain tips on social media for having a healthy pregnancy"*, and negative feelings as a direct consequence of social media use - *"I find it frustrating that only positive things are shown on social media, but the less pleasant things are often left out"*.

### **4.3 Development of novel risk factors and screening for distress during the perinatal period**

In this thesis, we found significant associations between three important novel risk factors, unplanned pregnancy, social media use and the COVID-19 pandemic, with higher levels of pregnancy-specific distress and perinatal depressive symptoms. It is important to screen for elevated levels of pregnancy-specific distress and depressive symptoms during the perinatal period, since it has been associated with adverse outcomes for the mother and for fetal and child development<sup>72-85</sup>. Screening for higher levels of psychological distress during the perinatal period is important for all pregnant women. However, it is important to keep both the well-known risk factors as well as the more novel risk factors, such as unplanned pregnancy, social media use and the COVID-19 pandemic, in mind. These women might be more at risk for experiencing elevated levels of distress during the perinatal period.

The TPDS and E(P)DS can be used to screen for psychological distress during pregnancy and postpartum. These are both cost-effective, valid, and reliable instruments. The TPDS has been specifically developed to measure elevated levels of pregnancy-specific distress. The scale was originally developed in Dutch but has already been translated into over six other languages. The E(P)DS is already used worldwide to screen for depressive symptoms during the perinatal period. It is encouraged to use these screening tools throughout the entire perinatal period, starting in the first trimester, to detect possible elevated levels of distress early in pregnancy so that healthcare professionals have enough time to offer adequate support throughout the whole perinatal period. These screening tools can be easily administered by midwives and obstetricians during pregnancy and by the general practitioners

and infant healthcare workers during the first postpartum year. However, these screening tools can also be administered online, for example by using a smartphone application. A smartphone application can also be used for treatment of elevated levels of distress in pregnant women, for example by incorporating psycho-educational information components and elements with therapeutic aspects, such as activities based on cognitive-behavioral therapy and mindfulness<sup>86</sup>. This application of technology could be very useful, as at the moment the waiting lists for psychological treatment are extremely long, especially for younger people, partly also due to the COVID-19 pandemic. An online alternative could enable women with mental health problems to start treatment sooner, which might ensure fewer longer-term effects of psychological distress<sup>87</sup>.

#### **4.4 Negative effects of distress during the perinatal period**

Experiencing psychological distress during the perinatal period is common, and the reported prevalence estimates of depressive symptoms during pregnancy vary between 11% and 18%<sup>2,3,5</sup> and postpartum between 15% and 25%<sup>4</sup>. It is of particular significance to make health care professionals more aware of the risk factors for perinatal mental health problems found in this thesis. Perinatal depressive symptoms do not solely affect the mother; they may also exert adverse effects on fetal and child development<sup>74,76</sup>. Perinatal distress has been associated with obstetric complications, such as pregnancy-induced hypertension, preterm birth, and low birth weight<sup>74,82,83</sup>. Moreover, the presence of perinatal distress has been linked to elevated parental stress levels for up to six months after childbirth, suboptimal mother-to-infant bonding<sup>88,89</sup>, but also impaired neurodevelopment, lower cognitive development, and later psychopathology in children<sup>76,85</sup>.

## **Section 5 – General conclusion**

This thesis addressed several novel risk factors for perinatal mental health problems. Associations between unplanned pregnancy, social media use and the COVID-19 pandemic with perinatal mental health problems were found. An unplanned pregnancy, even when it is not unwanted, has a potentially long-lasting negative impact on a woman's mental health during the entire perinatal period, since women with an unplanned pregnancy reported persistently higher levels of depressive symptoms up to 12 months postpartum. This thesis also showed an association

between both intensity of social media use and problematic social media use with higher levels of depressive symptoms during pregnancy. Social media use during pregnancy was shown to be lowest at 12 weeks of pregnancy and increased significantly at 20 weeks of pregnancy, after which it remained stable at 28 weeks of pregnancy. As described in this thesis, pregnant women use social media for many different purposes, for example to obtain information and to compare themselves to others. In addition to the negative consequences of the use of social media during pregnancy found in this thesis, it is also important to acknowledge that there are positive consequences for pregnant women to use social media (e.g., for support and information). Furthermore, it has also been shown that pregnancy-specific distress increased significantly in women during the COVID-19 pandemic. Taken together, given the results presented in this thesis, it is important for health care professionals to pay more attention to these novel risk factors, in addition to the well-known risk factors for perinatal mental health problems, because perinatal mental health problems have been linked to various adverse outcomes for both the mother and the child.

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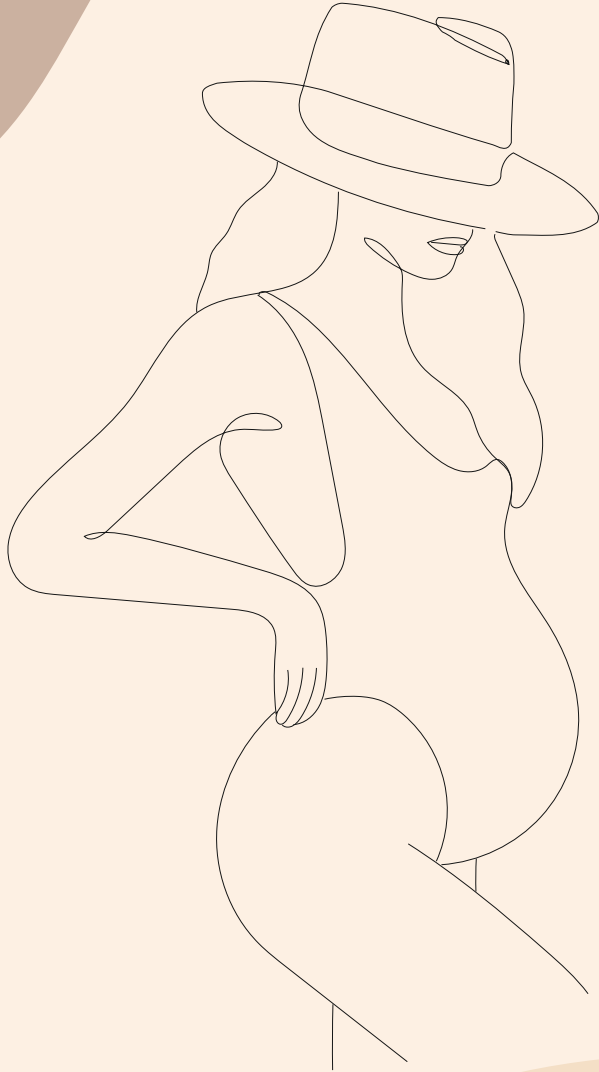
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# Appendix

**Summary**

**Nederlandse samenvatting (Dutch summary)**

**List of publications**

**Dankwoord (Acknowledgments)**

**About the author**

## Summary

The perinatal period is accompanied by multiple physical, psychological, and social changes. These changes might affect mental health outcomes in perinatal women, including perinatal psychological distress (e.g., depressive symptoms and pregnancy-specific distress symptoms). The main aim of the current thesis was to explore novel potential risk factors for maternal mental health problems during the perinatal period. This thesis specifically focused on the risk factors *unplanned pregnancy*, *social media use*, and the *COVID-19 pandemic*.

In **Chapter 2**, the association of unplanned pregnancy with perinatal depressive symptoms was investigated. Depressive symptoms were assessed during all trimesters of pregnancy (12, 22, and 32 weeks of pregnancy) and at five separate timepoints postpartum during the first postpartum year (1 week, 6 weeks, 4 months, 8 months, and 12 months postpartum). Linear mixed model analyses showed that women with an unplanned pregnancy reported persistently higher levels of depressive symptoms during the entire perinatal period compared to women with a planned pregnancy, after adjustment for confounders. However, the course of depressive symptom scores over time in women with an unplanned pregnancy was similar to that of women with a planned pregnancy. Lower age, unemployment, and history of depression were significantly associated with higher levels of perinatal depressive symptoms. A history of depression was more common in women with an unplanned pregnancy (30.9%) than women with a planned pregnancy (14.2%). A sensitivity analysis was therefore performed in a subgroup of women without a history of depression. This analysis showed similar results as in the full sample, suggesting that the association between unplanned pregnancy and perinatal depressive symptoms was not limited to women with a history of depression.

In Chapters **3**, **4**, and **5** it was investigated whether more intense and more problematic social media use were associated with higher levels of depressive symptoms during pregnancy. Intensity of social media use was measured by the time spent on social media and frequency of social media use, using questionnaires. Problematic social media use was assessed using the Bergen Social Media Addiction Scale (BSMAS). **Chapter 3** of this thesis explored the use of social media as a possible risk factor for more depressive symptoms during pregnancy. Growth mixture modeling was

used to determine longitudinal trajectories (identifying different classes/groups) of depressive symptoms. A three-class model was found, representing three different groups of women (classes) with similar patterns (trajectories) of depressive symptoms during pregnancy. The first class, a low stable class, was considered as the reference category and contained 70.2% of the women in the sample. This class represented the women with persistently low depression scores throughout the course of pregnancy. Secondly, an intermediate stable class was identified, which contained 26.3% of women in the sample. This class included women with persistent intermediate depression scores over the course of pregnancy. And lastly, a high stable class was found, which identified 3.6% of women in the sample and represented women with persistently high depression scores over the course of pregnancy. Subsequently, multinomial logistic regression analyses were used to examine the associations between social media use and these trajectories of depressive symptoms. The results showed that both *the time spent on social media* and *frequency of social media use* were significantly associated with belonging to the high stable class. *Problematic social media use*, based on the BSMAS, was significantly associated with belonging to the intermediate or high stable class. Further subgroup analyses, which excluded women with a previous history of depression (the only significant predictor of all covariates) showed similar results. Furthermore, overall, 6.3% of pregnant women were potentially addicted to social media in this study, based on the BSMAS cut-off score (scoring 3 or above on at least four of the six items of the BSMAS). Analysis of BSMAS cut-off scores across the established trajectories of depressive symptoms during pregnancy revealed that 3.3% of women in the reference category (the low stable class), 9.8% in the intermediate stable class, and 40% in the high stable class scored above the problematic social media use cut-off, which implies a potential addiction to social media. These findings underscore the importance of the association between problematic social media use with persistently high levels of depressive symptoms during pregnancy.

The longitudinal course of intensity of social media use (time and frequency) and problematic social media use (BSMAS) throughout pregnancy was examined in **Chapter 4**, using repeated measures analysis of variance (ANOVA). The results showed a significant change in social media use over time, for *the time spent on social media*, *frequency of social media use*, and *problematic social media use*. For all three social media variables, a similar pattern of change was found. Mean social media scores

were the lowest at 12 weeks of pregnancy and increased significantly at 20 weeks of pregnancy, after which they remained stable at 28 weeks. Additional analyses showed that in comparison to multiparous women, primiparous women spent more time on social media at 20 weeks of pregnancy, but not at 12 or 28 weeks.

In **Chapter 5**, the motives of women using social media during pregnancy, factors that play a role in possible changes in social media use, as well as the beneficial and adverse effects of the use of social media during pregnancy were investigated. Eleven individual in-depth semi-structured interviews were conducted with women who reported problematic social media use during pregnancy. Interviews were coded inductively, and codes were organized into themes using thematic analysis. The results of the interviews revealed three main themes: 1) *content consumed during pregnancy*, 2) *motives for social media use during pregnancy* and 3) *consequences of social media use during pregnancy*. The third main theme consisted of three subthemes: *consequences of comparison to others*, *consequences of using social media as an information source*, and *negative feelings as a direct consequence of social media use*. In addition, the self-report data of the Social Media Usage Aims Scale showed that women used social media mostly for passing time, maintaining existing relationships, entertainment and for informational and educational purposes. Based on the interviews, it can be concluded that social media use during pregnancy can lead to marked increases in negative feelings. However, pregnant women also report positive consequences of social media use, such as enhanced feelings of reassurance and recognition.

In **Chapter 6**, the impact of the COVID-19 pandemic on pregnancy-specific distress and depressive symptoms during the perinatal period was investigated. Linear mixed model analysis showed that pregnancy-specific distress symptoms increased significantly during pregnancy during the COVID-19 pandemic. However, no increase of depressive symptoms during pregnancy or in the postpartum period were found during the early phases of the pandemic.

The main findings of this thesis were discussed in **Chapter 7**. This chapter addressed methodological considerations and strengths and limitations of the research presented in this thesis. The General Discussion concluded with implications for future research and relevance for clinical practice.



## Nederlandse samenvatting (Dutch summary)

De periode van zwangerschap tot en met een jaar na de bevalling wordt gedefinieerd als de perinatale periode. De perinatale periode gaat gepaard met veel fysieke, psychologische en sociale veranderingen. Deze veranderingen kunnen van invloed zijn op de mentale gezondheid van vrouwen tijdens deze periode. Vrouwen kunnen bijvoorbeeld klachten van depressie en stress ervaren. Deze klachten worden vaak samen gedefinieerd als 'perinatale psychologische distress'. Het doel van dit proefschrift is om nieuwe potentiële risicofactoren voor mentale gezondheidsproblemen bij vrouwen tijdens de perinatale periode te onderzoeken. Dit proefschrift richt zich specifiek op de risicofactoren *ongeplande zwangerschap*, *gebruik van social media* en de *COVID-19 pandemie*.

In **Hoofdstuk 2** werd het verband tussen ongeplande zwangerschap en perinatale depressieve symptomen onderzocht. Depressieve symptomen werden gemeten met een vaak gebruikte vragenlijst in perinataal onderzoek, namelijk de Edinburgh (Postnatal) Depression Scale (E(P)DS). Deze vragenlijst werd tijdens alle trimesters van de zwangerschap (12, 22 en 32 weken zwangerschap) en op vijf afzonderlijke tijdstippen na de bevalling gedurende het eerste jaar na de geboorte (1 week, 6 weken, 4 maanden, 8 maanden en 12 maanden na de bevalling) afgenomen. De resultaten toonden aan dat vrouwen met een ongeplande zwangerschap hogere scores van depressieve symptomen rapporteerden gedurende de gehele perinatale periode in vergelijking met vrouwen met een geplande zwangerschap. Echter, het beloop van depressieve symptoomscores over de tijd bij vrouwen met een ongeplande zwangerschap was vergelijkbaar met dat van vrouwen met een geplande zwangerschap. Lagere leeftijd, het niet hebben van een betaalde baan, en een voorgeschiedenis van depressie waren significant geassocieerd met hogere niveaus van perinatale depressieve symptomen. Een voorgeschiedenis van depressie kwam vaker voor bij vrouwen met een ongeplande zwangerschap (30,9%) dan bij vrouwen met een geplande zwangerschap (14,2%). Daarom werd er een extra sensitiviteitsanalyse uitgevoerd in een subgroep van vrouwen zonder een voorgeschiedenis van depressie. Deze analyse toonde vergelijkbare resultaten als in de volledige onderzoeksgroep, wat suggereert dat het verband tussen een ongeplande zwangerschap en perinatale depressieve symptomen niet beperkt was tot vrouwen met een voorgeschiedenis van depressie.

In de **Hoofdstukken 3, 4 en 5** werd onderzocht of intensiever en problematischer gebruik van social media samenhangen met hogere niveaus van depressieve symptomen tijdens de zwangerschap, met verschillende onderzoeksmethodes. De intensiteit van het gebruik van social media werd gemeten aan de hand van de tijd die werd gespendeerd op social media en de frequentie van het gebruik van social media. Problematisch gebruik van social media werd gemeten met behulp van de Bergen Social Media Addiction Scale (BSMAS), deze vragenlijst meet social media verslaving. **Hoofdstuk 3** van dit proefschrift onderzocht het gebruik van social media als een mogelijke risicofactor voor meer depressieve symptomen tijdens de zwangerschap. Er werd onderzocht of er bepaalde groepen (klassen) vrouwen een vergelijkbaar beloop (trajectories) van depressieve symptomen lieten zien gedurende de zwangerschap. Er werden drie verschillende groepen vrouwen geïdentificeerd met eenzelfde patroon van depressieve symptomen van het eerste tot en met het derde trimester. De eerste groep liet een patroon zien van lage intensiteit van depressieve symptomen gedurende de gehele zwangerschap (groep 1, referentiegroep, 70,2% van de totale onderzoeksgroep). De tweede groep liet een patroon zien van milde verhoogde intensiteit van depressieve symptomen gedurende de gehele zwangerschap (groep 2, 26,3% van de totale onderzoeksgroep). Tot slot, de derde groep liet een patroon zien van hoge intensiteit van depressieve symptomen gedurende de gehele zwangerschap (groep 3, 3,6% van de totale onderzoeksgroep). Vervolgens werden de verbanden tussen het gebruik van social media en deze verschillende groepen vrouwen met depressieve symptomen onderzocht. De resultaten toonden aan dat zowel *de tijd besteed op social media* als *de frequentie van het gebruik van social media* significant samenhangen met het behoren tot de groep vrouwen met hoge intensiteit van depressieve symptomen gedurende de hele zwangerschap. *Problematisch gebruik van social media* was significant geassocieerd met het behoren tot zowel de groep vrouwen met milde verhoogde intensiteit van depressieve symptomen gedurende de hele zwangerschap als tot de groep vrouwen met hoge niveaus van depressieve symptomen. Verdere sensitiviteitsanalyses, waarbij vrouwen met een voorgeschiedenis van depressie werden uitgesloten, lieten vergelijkbare resultaten zien. Bovendien was in dit onderzoek 6,3% van de zwangere vrouwen mogelijk 'verslaafd' aan social media, gebaseerd op de cut-off score van de BSMAS (score 3 of hoger op ten minste vier van de zes items van de BSMAS). Het analyseren van de BSMAS cut-off scores per groep vrouwen met eenzelfde patroon van depressieve symptomen tijdens de zwangerschap, liet zien dat 3,3% van de vrouwen in groep 1

(lage scores van depressie) 9,8% in groep 2 (middelmatige scores van depressie) en 40% in groep 3 (hoge scores van depressie) boven de cut-off voor problematisch social media gebruik scoorden, wat een potentiële verslaving aan social media impliceert. Deze bevindingen benadrukken het belang van het verband tussen problematisch social media gebruik en aanhoudende hoge mate van depressieve symptomen tijdens de zwangerschap.

Het beloop van de intensiteit van social media gebruik (tijd en frequentie) en problematisch social media gebruik (BSMAS) gedurende de zwangerschap van het eerste tot en met het derde trimester werd onderzocht in **Hoofdstuk 4**. De resultaten toonden een significante verandering in het gebruik van social media over de tijd, voor *de tijd besteed op social media, de frequentie van het gebruik van social media en het problematisch gebruik van social media*. De gemiddelde scores voor social media gebruik waren het laagst rond 12 weken zwangerschap en stegen significant rond 20 weken zwangerschap, waarna ze stabiel bleven rond 28 weken. Hetzelfde patroon werd gevonden voor zowel de tijd die besteed werd op social media, de frequentie van het gebruik van social media, evenals het problematisch gebruik van social media. Aanvullende analyses toonden aan dat in vergelijking met vrouwen die al eens bevallen waren, vrouwen die nog nooit bevallen waren meer tijd besteedden aan social media rond 20 weken zwangerschap, maar niet rond 12 of 28 weken zwangerschap.

In **Hoofdstuk 5** werden de motieven van vrouwen die social media gebruiken tijdens de zwangerschap, factoren die een rol spelen bij mogelijke veranderingen in het gebruik van social media en de positieve en negatieve gevolgen van het gebruik van social media tijdens de zwangerschap onderzocht. Elf individuele diepte-interviews (semigestructureerd) werden afgenomen met vrouwen die problematisch gebruik van social media tijdens de zwangerschap rapporteerden. De interviews werden inductief gecodeerd en aan de hand van de codes werden thema's geïdentificeerd met behulp van thematische analyse. Uit de interviews kwamen drie hoofdthema's naar voren: 1) *type social media gebruik tijdens de zwangerschap*, 2) *motieven voor social media gebruik tijdens de zwangerschap* en 3) *gevolgen van social media gebruik tijdens de zwangerschap*. Het derde hoofdthema bestond uit drie subthema's: *gevolgen van vergelijking met anderen, gevolgen van het gebruik van social media als informatiebron en negatieve gevoelens als direct gevolg van het gebruik van social media*. Daarnaast vulden de

vrouwen de Social Media Usage Aims Scale in. Resultaten na het analyseren van deze vragenlijsten lieten zien dat vrouwen social media vooral gebruikten voor tijdverdrijf, het onderhouden van bestaande relaties, entertainment en voor informatieve en educatieve doeleinden. Op basis van de interviews kan worden geconcludeerd dat het gebruik van social media tijdens de zwangerschap kan leiden tot aanzienlijke toenames in negatieve gevoelens. Echter, zwangere vrouwen rapporteerden ook positieve gevolgen van het gebruik van social media, zoals versterkte gevoelens van geruststelling en herkenning.

In **Hoofdstuk 6** werd de invloed van de COVID-19 pandemie op zwangerschaps-specifieke distress en depressieve symptomen tijdens de perinatale periode onderzocht. De resultaten lieten zien dat zwangerschaps-specifieke distress-symptomen tijdens de COVID-19 pandemie significant toenamen tijdens de zwangerschap. Er werd echter geen toename van depressieve symptomen tijdens de zwangerschap of in de periode na de bevalling gevonden tijdens de pandemie.

De belangrijkste bevindingen van dit proefschrift werden besproken in **Hoofdstuk 7**. Dit hoofdstuk beschreef de methodologische overwegingen en de sterke punten en beperkingen van het onderzoek in dit proefschrift. De Algemene Discussie werd afgesloten met implicaties voor toekomstig onderzoek en de relevantie voor de klinische praktijk.

## List of publications

**Muskens L**, van den Heuvel MI, Pop VJM, Boekhorst MGBM. Motives and consequences of social media use during pregnancy: a qualitative study. *Under review*.

**Muskens L**, van den Heuvel MI. Social media gebruik tijdens de zwangerschap. Vakblad Vroeg. *Under review*.

Weinstein AA, van Aert RCM, Donovan K, **Muskens L**, Kop WJ. Affective responses to acute exercise: A meta-analysis of the potential beneficial effects of a single bout of exercise on general mood, anxiety, and depressive symptoms. *Psychosom Med*. 2024.

**Muskens L**, Boekhorst MGBM, Pop VJM, van den Heuvel MI. Browsing throughout pregnancy: The longitudinal course of social media use during pregnancy. *Midwifery*. 2024;129:103905.

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## Dankwoord (Acknowledgments)

Wauw, het is me gelukt en wat ben ik trots op het eindresultaat. In dit dankwoord wil ik graag iedereen bedanken die mij heeft geholpen en gesteund bij de totstandkoming van mijn proefschrift.

Als eerste wil ik graag alle vrouwen die hebben deelgenomen aan de HAPPY-studie en Brabant Studie bedanken voor hun inzet. Zonder jullie deelname had ik dit proefschrift niet kunnen schrijven.

Mijn promotoren en copromotor wil ik bedanken voor de begeleiding en fijne samenwerking. Jullie vormden samen een ontzettend fijn promotieteam, waarbij ieder zijn eigen waardevolle en unieke inbreng had.

*Prof. dr. Pop, beste Victor*, wat heb ik veel van jou mogen leren. Het is mooi om te zien hoeveel passie jij hebt voor het uitvoeren van wetenschappelijk onderzoek. Ik ben enorm dankbaar dat jij mijn promotor bent. Je was altijd zo betrokken bij alles. Ik kon bij je terecht met vragen en voor advies. Het was zeer waardevol dat je zelfs na je pensioen nog steeds iedere dinsdag aanwezig bent op de universiteit. Het was fijn om dan weer even bij te praten. Dank voor je vertrouwen in mij en de kansen die jij mij hebt gegeven. We houden contact!

*Prof dr. Kop, beste Wijo*, ik wil je bedanken voor alle kansen die jij mij geboden hebt. In 2019 mocht ik bij jou mijn masteronderzoek uitvoeren en mijn thesis schrijven. Wat heb ik toen veel van je geleerd. Na mijn studie zocht je actief mee naar een passende baan voor mij. Dankzij jouw aanbeveling bij het Brabant Studie team mocht ik op gesprek komen, waarna ik werd aangenomen. Ik was enorm blij toen ik hoorde dat jij mijn tweede promotor werd. Je bent altijd een zeer betrokken promotor geweest, zowel op werk- als privégebied. Ik liep altijd graag even bij je binnen om bij te praten, en dat zal ik zeker in de toekomst nog eens doen!

*Dr. van den Heuvel, beste Marion*, dank voor jouw begeleiding en steun de afgelopen jaren. Ook van jou heb ik veel mogen leren. Buiten mijn dagelijkse werkzaamheden als promovenda heb je mij ook veel kansen geboden om mij daarbuiten verder te ontwikkelen. Je was altijd zeer betrokken bij mij als persoon en oprecht geïnteresseerd

in hoe het met mij ging. Ook wil ik je bedanken voor je belangstelling in en het meedenken over mijn verdere carrière. We maken snel weer samen een wandeling om gezellig bij te praten!

Ik wil graag de leden van de commissie, *Prof. dr. van Baar, Prof. dr. Bongers, Prof. dr. Smeets, Dr. Potharst* en *Dr. Wijnen*, hartelijk bedanken voor het lezen en beoordelen van dit proefschrift. Ik kijk uit naar mijn verdediging op 28 juni 2024.

Alle coauteurs wil ik bedanken voor hun bijdrage aan de verschillende hoofdstukken van dit proefschrift. Ik heb veel van jullie geleerd, dank voor de fijne samenwerking.

Daarnaast wil ik alle verloskundigen in de regio Eindhoven en Tilburg bedanken voor het werven van alle vrouwen voor de HAPPY-studie en Brabant Studie.

Het team van de HAPPY-studie wil ik hartelijk bedanken voor al hun harde werk en inzet. Fijn dat ik de data van de HAPPY-studie mocht gebruiken voor het schrijven van een van de hoofdstukken in dit proefschrift.

Uiteraard wil ik mijn (ex-)collega's van de Brabant Studie enorm bedanken. *Margreet, Myrthe, Lianne, Noor, Frederieke, Lisette, Katleen, Irene, Bram* en *Charlotte*, dank voor alle fijne Brabant Studie meetings maar ook de gezellige borrels en etentjes. Ik heb met heel veel plezier met jullie samengewerkt. Ik ben erg dankbaar dat ik mijn promotietraject met jullie als onderzoeksteam heb mogen doorlopen. Heel veel succes met de verdere voortzetting van deze mooie studie!

Daarnaast wil ik ook de vele studenten die ons hebben geholpen met de dataverzameling voor de Brabant Studie bedanken. Jullie bijdrage is zeer waardevol geweest voor zowel de studie als mijn proefschrift.

Alle collega's van Tilburg University wil ik bedanken, met in het bijzonder de (ex-)collega's van MKP. Dank voor de prettige samenwerking, alle fijne gesprekken, gezellige lunches en borrels. Ook wil ik natuurlijk mijn lieve AIO-collega's bedanken, *Abbie, Bo, Carmen, Charlotte, Daniëlle, Dinah, Ellen, Emma, Eveline, Eveline, Frederieke, Hilde, Isabel, Jamie, Janniek, Lisa, Manon, Marijn, Nina, Noor, Rosie, Sandra, Silke, Sophie* en *Tom*. Wat heb ik het fijn gehad samen met jullie. Ik ben enorm dankbaar dat MKP een

grote hechte groep AIO's heeft. Bedankt voor alle fijne gesprekken en jullie steun, maar ook bedankt voor alle gezellige AIO-uitjes en de geweldige schrijfweken. Ik zal nog vaak terugdenken aan deze mooie momenten samen. Heel veel succes met jullie promotietrajecten. Ik blijf graag op de hoogte!

Ik wil mijn lieve (ex-)kamergenootjes van T509A bedanken, *Emma, Janniek, Laura en Stefanie*. Jullie aanwezigheid, steun en hulp hebben mijn promotietraject zoveel fijner en leuker gemaakt. Bedankt voor alles!

*Emma, Lianne en Myrthe*, ik ben zo blij dat jullie mijn paranimfen zijn. Jullie begrijpen mij zo goed, en ik heb zoveel steun aan jullie tijdens de voorbereidingen voor mijn promotie. Ik ben enorm blij dat jullie straks tijdens mijn promotie achter mij staan!

*Emma*, jij hoeft dit proefschrift eigenlijk niet meer te lezen, op dit dankwoord na dan. Vanaf het moment dat jij bij ons op de kamer kwam hadden wij meteen een enorm goede klik. Dit is de laatste jaren alleen maar sterker geworden. Ik zie je oprecht als een hele goede vriendin. Wat kunnen wij fijn samen praten, maar wat kunnen wij ook veel lachen samen. Jij hebt mijn tijd als AIO echt zoveel leuker en makkelijker gemaakt! Ik ben enorm trots op jou! Bedankt voor alles! Warme groetjes!

*Lianne*, wat heb ik veel van jou mogen leren, van het uitvoeren van analyses in R tot het beter aangeven van mijn grenzen. Ik wil je bedanken voor alle fijne en gezellige gesprekken. Jij was er altijd voor mij, je toont altijd enorm veel belangstelling en begrijpt mij zo goed. Wat hebben we een geweldige tijd gehad in Londen, we hebben genoten van het congres maar ook zeker van de gezellige vrije avondjes. Heel veel succes met je verdere carrière, ik ben trots op je!

*Myrthe*, wat heb jij veel voor mij betekend de afgelopen jaren. Ik heb je altijd gezien als een extra copromotor. Ik kon jou alles vragen, niks was te veel. Jij hebt mij zoveel geleerd en laten inzien dat ik echt op mezelf mag vertrouwen. Jij hebt mij overal bij gesteund, zowel op werkgebied als privé. Wat kunnen wij goed praten samen, maar ook lachen! Ik ben onwijs trots op hoe jij alles doet, daar heb ik veel respect voor!

Lieve waterpolo-teamgenootjes, ik wil jullie bedanken voor jullie interesse in mijn promotietraject. Maar bovenal bedanken voor de fijne trainingen iedere maandag



en donderdag en de leuke feestjes. Dit is altijd een goede afleiding geweest van mijn werk. Op naar nog vele gezellige momenten!

Lieve vriendinnen, *Bente, Chantal, Ilse, Joyce, Karlijn, Marloes, Maxime en Pauline*, jullie zijn zo belangrijk voor mij. Ik wil jullie allemaal bedanken voor jullie vriendschap. Dank voor jullie interesse in mijn werk en proefschrift de afgelopen jaren. Maar vooral dank voor alle mooie momenten samen. Jullie zorgen voor veel gezelligheid en ontspanning!

En dan tot slot, wil ik de belangrijkste personen in mijn leven bedanken, mijn familie.

Lieve *Elke* en *Floor*, wat ben ik ongelooflijk dankbaar voor de hechte zussenband die wij hebben. We kunnen alles met elkaar bespreken en hebben zoveel plezier samen. Jullie zijn er oprecht altijd voor mij. Ik wil jullie daar enorm voor bedanken, en ik zal er ook altijd voor jullie zijn! Ik ben zo trots op jullie, op alles wat jullie doen. Dikke knuffel!

Lieve *mama*, het is moeilijk om uit te drukken hoe dankbaar ik jou ben voor alles! Jij bent zo ongelooflijk belangrijk voor mij. Jij steunt mij bij alles. Er is niemand die mij zo goed begrijpt als jij. Als ik het moeilijk heb, ben jij degene die mij helpt en motiveert om door te gaan. Je gelooft altijd in mij. De band die wij hebben vind ik heel speciaal. Naast dat ik heel goed met je kan praten kunnen wij ook zoveel lol hebben samen. Dat is erg waardevol voor mij. Ook ben ik enorm trots op jou en heb ik heel veel respect voor jou, wat ben jij een sterke vrouw! Bedankt voor alles, lieve mama! Love you!

Lieve *papa*, wat mis ik je, ... Wat was je trots toen ik in november 2019 mocht beginnen als promovenda bij Tilburg University. Ik ben zo blij dat je dit nog hebt meegemaakt en vind het moeilijk dat ik het eindresultaat van mijn proefschrift niet met je kan delen. De gedachte aan jou heeft mij altijd gemotiveerd om door te zetten en niet op te geven in moeilijke tijden. Ik weet zeker dat je heel trots op mij zou zijn, net zo trots als op mama, Elke en Floor. Ik heb altijd het gevoel dat je heel dicht bij me bent, in mijn hart! Ik hou van je.

Lotte

## **About the author**

Lotte Muskens was born on the 19<sup>th</sup> of April in 1996 in 's-Hertogenbosch, the Netherlands. She completed her pre-university education in 2014 at 2College Durendael in Oisterwijk. In 2018 she obtained her Bachelor's degree in Psychology at Tilburg University. After receiving her Master's degree in Health and Social Psychology at Maastricht University in 2019, she started her PhD research at the department of Medical and Clinical Psychology at Tilburg University in November 2019.



