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Trait mindfulness scores are related to trajectories of depressive symptoms during pregnancy

Lianne P. Hulsbosch [a,*], Myrthe GBM. Boekhorst [a], Joyce Endendijk [b], Ivan Nyklíček [a], Eva S. Potharst [c,d], Victor JM. Pop [a]

[a] Center of Research in Psychological and Somatic Disorders (CoRPS), Department of Medical and Clinical Psychology, Tilburg University, Tilburg, the Netherlands
[b] Child and Adolescent Studies, Utrecht University, Utrecht, the Netherlands
[c] UvA Minds, Academic Outpatient (child and Adolescent) Treatment Center of the University of Amsterdam, Amsterdam, the Netherlands
[d] Research Institute of Child Development and Education, University of Amsterdam, Amsterdam, the Netherlands

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ABSTRACT

Background: Exploring possible protective factors against antenatal depression is important since antenatal depression is common and affects both mother and child. The person characteristic trait mindfulness may be such a protective factor. Because of the high variability in depressive symptoms over time, we aimed to assess the association between trait mindfulness and trajectories of depressive symptoms during pregnancy.

Methods: A subsample of 762 women participating in the HAPPY study completed the Three Facet Mindfulness Questionnaire-Short Form at 22 weeks of pregnancy. Possible different trajectories of Edinburgh Postnatal Depression Scale (EPDS) scores, assessed at each pregnancy trimester, were explored with growth mixture modeling.

Results: Three EPDS trajectories (classes) were identified: low stable symptom scores (N = 607, 79.7%), decreasing symptom scores (N = 74, 9.7%) and increasing symptom scores (N = 81, 10.6%). Compared to belonging to the low stable class (reference), women with higher scores on the trait mindfulness facets 'acting with awareness' and 'non-judging' were less likely to belong to the decreasing class (OR = 0.81, 95% CI [0.73, 0.90] and OR = 0.77, 95% CI [0.70, 0.84]) and increasing class (OR = 0.88, 95% CI [0.80, 0.97] and OR = 0.72, 95% CI [0.65, 0.79]). Women with higher scores on 'non-reacting' were less likely to belong to the increasing class (OR = 0.89, 95% CI [0.82, 0.97]), but not the decreasing class (OR = 0.96, 95% CI [0.87, 1.04]). All analyses were adjusted for confounders.

Conclusions: Characteristics of trait mindfulness predicted low stable levels of depressive symptoms throughout pregnancy. Mindfulness-based programs may be beneficial for pregnant women as a strategy to alleviate depression risks.

1. Introduction

Gaining insight into factors that could protect against antenatal depression is of great importance, since up to 15% of pregnant women suffer from depression, with symptoms varying throughout pregnancy (Guo et al., 2021; Okagbue et al., 2019; Woody et al., 2017). Antenatal depression can have consequences for both mother and child, as it is a risk factor for postpartum depression and can affect fetal outcomes (e.g. premature birth, low birth weight and intrauterine growth restriction) and infant development (Field, 2011; Grote et al., 2010; Liu et al., 2017). Infant development could be affected by postpartum depression as well, and the latter could furthermore affect parenting and mother-infant interaction (Beck, 1998; Myers and Johns, 2018; O'Hara and McCabe, 2013).

Pregnant women who have a predisposition for a mindful attitude may have a lower risk for heightened levels of depressive symptoms. This person's attitude to be mindful, defined as trait mindfulness, is described as the capacity of paying and maintaining attention to present-moment experiences with an open and nonjudgmental attitude (Brown and Ryan, 2003). Trait mindfulness is a person characteristic, and

* Corresponding author. Tilburg University, Department of Medical and Clinical Psychology, P.O. BOX 90153, 5000, LE, Tilburg, the Netherlands.
E-mail addresses: l.p.hulsbosch@tilburguniversity.edu (L.P. Hulsbosch), m.g.b.m.boekhorst@tilburguniversity.edu (M.GBM. Boekhorst), j.j.endendijk@uu.nl (J. Endendijk), i.nyklicek@tilburguniversity.edu (I. Nyklíček), epotharst@uvaminds.nl (E.S. Potharst), v.j.m.pop@tilburguniversity.edu (V.JM. Pop).

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relatively stable over time without a mindfulness intervention (Jensen et al., 2016, 2019; Veehof et al., 2011), although the stability of trait mindfulness has not been studied during pregnancy. State mindfulness is highly variable over time and dependent on the situation (Bishop et al., 2004; Tanay and Bernstein, 2013). State mindfulness can be conceptualized as a psychological process, that can be practiced during mindfulness meditation (Bishop et al., 2004; Kiken et al., 2015). In a study on change in state mindfulness after practicing weekly meditations during an eight-week mindfulness intervention, it was shown that state mindfulness, after practicing a meditation, improved during the eight-week mindfulness training (Kiken et al., 2015). This study also showed that greater improvement of state mindfulness, after practicing a meditation, predicted a greater improvement in trait mindfulness after the intervention as compared to before the intervention (Kiken et al., 2015). In an eight-week mindfulness intervention, trait mindfulness can thus gradually be strengthened by increasing state mindfulness with meditation practice (Kiken et al., 2015). A meta-analysis on mindfulness interventions for pregnant women indeed showed that six- to nine-week mindfulness interventions did have a positive effect on trait mindfulness (Dhillon et al., 2017).

Trait mindfulness has been associated with many psychological health aspects, including optimism and enhanced life satisfaction (Brown and Ryan, 2003). Few previous studies have examined the association between trait mindfulness and depressive symptoms (Branstrom et al., 2011; Cash and Whittingham, 2010; Krusche et al., 2019; Nyklíček et al., 2015), but most of these studies did not focus on pregnant populations and, more importantly, used single measurements of depressive symptoms. However, the course of depressive symptoms is extremely variable over time, both within and between individuals (Bailey et al., 2021; Baron et al., 2017; Santos et al., 2017). Therefore, we believe that repeated assessments of depressive symptoms are of great importance, to be able to take the considerable (individual) symptom variability into account. The current study used three repeated measurements of depressive symptoms (in each pregnancy trimester) to identify different trajectories of women who show similar patterns of symptoms throughout pregnancy.

The current study aimed to examine whether trait mindfulness was associated with trajectories of depressive symptoms during pregnancy. The first hypothesis was that we expected to identify different trajectories of depressive symptoms, due to the high variability in symptoms over time (Bailey et al., 2021; Baron et al., 2017; Santos et al., 2017). The second hypothesis was that trait mindfulness would be independently and inversely associated with those trajectories that showed elevated levels of depressive symptoms, due to the previously reported negative association between trait mindfulness and depressive symptoms in cross-sectional studies and/or non-pregnant populations (Branstrom et al., 2011; Cash and Whittingham, 2010; Krusche et al., 2019; Nyklíček et al., 2015).

2. Material and methods

2.1. Procedure

The current study was part of a longitudinal prospective cohort study in the south of the Netherlands, the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study, of which details are described elsewhere (Truijens et al., 2014). Between January 2013 and September 2014, Dutch speaking women were recruited at the first antenatal visit. Exclusion criteria were multiple pregnancy, severe psychiatric disorder (e.g. schizophrenia, borderline personality disorder and bipolar disorder) and/or a documented history of chronic disease (e.g. diabetes and thyroid dysfunction). The HAPPY study was carried out in accordance with the latest version of the Declaration of Helsinki (WMA, 2013). The HAPPY study was approved by the ethical committee of Tilburg University (protocol number EV-2012.25) and reviewed by the Medical Ethics Committee of the Máxima Medical Centre Veldhoven. Written informed consent was obtained from all participating women (N = 2269).

2.2. Participants

Participating women filled out questionnaires at three trimesters of pregnancy. Only the women that were included between March and December 2013 were asked to complete an additional questionnaire at 22 weeks of pregnancy for assessment of trait mindfulness (N = 911). Moreover, we set the timeframe to complete the assessment of depressive symptoms at the three trimesters of pregnancy at ± four weeks of 12, 22 and 32 weeks of gestation. Exclusion of women who did not complete assessment of depressive symptoms at the correct timeframe (N = 147) and with missing data on education level (N = 2) resulted in a final study sample of 762 women.

2.3. Measures

2.3.1. Depressive symptoms during pregnancy

Depressive symptoms in each trimester were assessed by means of the 10-item Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). Total EPDS scores range from 0 to 30, with higher scores reflecting more symptoms of depression. The EPDS has been validated in Dutch pregnant women for measurement of depression in each trimester of pregnancy (Bergink et al., 2011). In the current study, the Cronbach's alphas were 0.83, 0.84 and 0.82 per trimester respectively.

2.3.2. Trait mindfulness during pregnancy

Trait mindfulness during pregnancy was assessed with the 12-item Three Facet Mindfulness Questionnaire-Short Form (TFMQ-SF) at 22 weeks of pregnancy (Truijens et al., 2016). The TFMQ-SF includes three subscales, each measuring a different facet of mindfulness: (1) *acting with awareness*, being attentive to present moment experiences, (2) *non-judging* of thoughts and feelings, and being accepting towards them, (3) *non-reacting* to troubling thoughts and feelings. The total scores of each subscale range from 4 to 20 and higher scores indicate higher levels of mindfulness. The TFMQ-SF has shown to have adequate reliability and validity in Dutch pregnant women (Truijens et al., 2016). The Cronbach's alphas were 0.87, 0.81 and 0.80, respectively per subscale in the current study.

2.3.3. Descriptive characteristics

Several possible confounders of depressive symptoms were assessed at 12 weeks of gestation including *age*, *education level* (low or medium/high (high = Bachelor's degree or higher)), *employment* (yes/no), *living with partner* (yes/no), *BMI* (pre-pregnancy), *smoking during pregnancy* (yes/no), *alcohol use during pregnancy* (yes/no), *parity* (primiparous/multiparous), *previous miscarriage* (yes/no), *unplanned pregnancy* (yes/no) and *history of depression* (yes/no).

2.4. Statistical analyses

To estimate longitudinal trajectories (classes) of depressive symptoms during pregnancy growth mixture modeling was performed in Mplus version 8.5 (Muthén and Muthén, 1998–2017). These trajectory analyses were completed by using EPDS total scores at 12, 22 and 32 weeks of gestation with MLR estimation (maximum likelihood estimation with robust standard errors) since the EPDS scores were positively skewed. After fitting a one-class model, we fitted models with an increasing number of classes. To determine the optimal number of classes we considered the Bayesian Information Criterion (BIC), Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT), Bootstrapped Likelihood Ratio Test (BLRT) and entropy (Jung and Wickrama, 2008; Nylund et al., 2007). Lower BIC values indicate a model with a better fit (Collins and Lanza, 2010). A significant LMR-LRT and BLRT indicate that a model with an additional class is a better fit to the data. Entropy

values closer to 1 indicate a clearer separation of classes and a more optimal fit of individuals in their respective class (Collins and Lanza, 2010). In addition, when deciding on the optimal number of classes the parsimony and interpretability of the models were taken into account (Jung and Wickrama, 2008).

For further analyses, a variable that indicated the trajectory (class) membership of each participant was subsequently entered into R (version 3.6.3). To examine changes in depressive symptom mean scores over time we performed repeated measures (RM) ANOVA. To compare depressive symptom mean scores between the established trajectories we used one-way ANOVA with post-hoc Tukey analyses. In addition, one-way ANOVA and chi-square tests were performed to analyze differences in participant characteristics (facets of mindfulness and confounders) between the established trajectories. Subsequently, the three facets of mindfulness were included in a multinomial logistic regression analysis as the independent variables, with the established trajectories of depressive symptoms as the dependent variable. We adjusted for the confounders that showed a significant association with the established trajectories at a univariate level ($p < .05$). The trajectory that included the highest percentage of women was set as the reference category.

3. Results

The characteristics of the current sample of 762 women are shown in Table 1. Compared to the remainder of the HAPPY sample ($N = 1507$), the current sample was more often highly educated ($\chi^2(1) = 4.4$, $p = .036$), more often primiparous ($\chi^2(1) = 5.5$, $p = .019$) and smoked less often ($\chi^2(1) = 6.6$, $p = .010$), all with small effect sizes. No significant differences were found for age, employment, living with partner, BMI, use of alcohol, previous miscarriage, unplanned pregnancy and previous depression.

3.1. Longitudinal trajectories of depressive symptoms during pregnancy

The fitindices (BIC, LMR-LRT, BLRT) and entropy indicated both the three- and four-class model to be suitable in representing longitudinal trajectories of depressive symptoms during pregnancy (Supplementary Table 1). When taking into account the parsimony and interpretability of both models, we chose the three-class model as optimal model. The three depressive symptom classes are shown in Fig. 1. The labels of the three classes were based on the mean depressive symptom scores (EPDS) at 12, 22 and 32 weeks of pregnancy. Class 1 ($N = 607$, 79.7%) showed a low and stable pattern of depressive symptoms during pregnancy with a mean varying between 3.0 and 3.9 between 12 and 32 weeks of pregnancy, and was labeled *"Low stable"*, indicating that depression was not likely at all measurement points. This class represented the reference category. Class 2 ($N = 74$, 9.7%) showed a significant decrease in depressive symptoms throughout pregnancy (from a mean of 13.3 at 12 weeks to 7.8 at 32 weeks of pregnancy, RM ANOVA: $F(1.59) = 46.1$, $p < .001$, $\eta^2_G = 0.23$, large effect size), and was labeled *"Decreasing"*. Class 3 ($N = 81$, 10.6%) showed an increasing pattern of depressive symptoms during pregnancy (from a mean of 7.4 at 12 weeks to 12.1 at 32 weeks of pregnancy, RM ANOVA: $F(1.53) = 36.1$, $p < .001$, $\eta^2_G = 0.24$, large effect size), and was labeled *"Increasing"*.

The depressive symptom mean scores showed significant differences between the three classes in each trimester of pregnancy (ANOVA: $F(2, 727$ to $759) = 249.2$ to 524.8, all $p < .001$, $\eta^2 = 0.40$ to 0.58) with large effect sizes. Compared to the low stable class, the depressive symptom mean scores were in each trimester significantly higher in both the decreasing and increasing class (Post-hoc Tukey: all $p < .001$).

Table 1
Characteristics of 762 pregnant women.

	N (%)	Mean (SD)
Demographics		
Age		30.2 (3.5)
High level of education	503 (66.0)	
Employment	692 (90.8)	
Living with partner	751 (8.6)	
Lifestyle habits		
BMI (pre-pregnancy)		23.7 (3.9)
Smoking during pregnancy	35 (4.6)	
Alcohol during pregnancy	35 (4.6)	
Obstetrics		
Multiparity	360(47.2)	
Previous miscarriage	188 (24.7)	
Unplanned pregnancy	41 (5.4)	
Psychological features		
Previous depression	108 (14.2)	
TFMQ-SF		
Acting with awareness		14.5 (3.2)
Non-judging		16.2 (3.1)
Non-reacting		11.6 (4.1)

SD, standard deviation; high level of education, Bachelor's degree or higher; BMI, body mass index; TFMQ-SF, Three Facet Mindfulness Questionnaire-Short Form.

3.2. Trait mindfulness in relation to trajectories of depressive symptoms during pregnancy

As shown in Table 2, significant differences were found between women belonging to the different trajectories of depressive symptoms for the mindfulness facets acting with awareness (ANOVA, $F(2,759) = 29.7$, $p < .001$, $\eta^2 = 0.07$, medium effect size) and non-judging ($F(2,759) = 71.3$, $p < .001$, $\eta^2 = 0.16$, large effect size). Moreover, significant differences between these three groups of women were found for high level of education ($\chi^2(2) = 17.2$, $p < .001$, Cramer's V = 0.15), employment ($\chi^2(2) = 7.5$, $p = .024$, Cramer's V = 0.10), living with partner ($\chi^2(2) = 17.9$, $p = .001$, Cramer's V = 0.15), previous miscarriage ($\chi^2(2) = 8.3$, $p = .016$, Cramer's V = 0.10) and previous depression ($\chi^2(2) = 23.4$, $p < .001$, Cramer's V = 0.18), all with small effect sizes.

The multinomial logistic regression model included the three facets of mindfulness (acting with awareness, non-judging and non-reacting) and five confounders that showed a significant association at univariate level (level of education, employment, living with partner, previous miscarriage and previous depression). The model was statistically significant ($\chi^2(16) = 192.9$, $p < .001$, Table 3). Higher acting with awareness (OR = 0.81, 95% CI [0.73, 0.90], $p < .001$) and non-judging scores (OR = 0.77, 95% CI [0.70, 0.84], $p < .001$) were associated with a lower likelihood of belonging to the decreasing class compared to the likelihood of belonging to the low stable class (reference category). However, non-reacting scores were not different between the low stable and decreasing class (OR = 0.96, 95% CI [0.87, 1.04], $p = .333$). Moreover, higher acting with awareness (OR = 0.88, 95% CI [0.80, 0.97], $p = .009$), non-judging (OR = 0.72, 95% CI [0.65, 0.79], $p < .001$) and non-reacting scores (OR = 0.89, 95% CI [0.82, 0.97], $p = .007$) were related to a lower likelihood of belonging to the increasing class compared to the likelihood of belonging to the low stable class. The odds ratios can be interpreted as follows. Per unit increase in non-judging, the likelihood of belonging to the decreasing or increasing class decreased with 23% (decreasing) or 28% (increasing). Per unit increase in acting with awareness, the likelihood of belonging to the decreasing or increasing class decreased with 19% (decreasing) or 12% (increasing). Per unit increase in non-reacting, the likelihood of belonging to the increasing class decreased with 11%. With regard to the confounders, a previous miscarriage (OR = 2.10, 95% CI [1.17, 3.76], $p = .013$) and a previous episode of a depression (OR = 2.46, 95% CI [1.32, 4.61], $p = .005$) were significantly associated with a higher likelihood of belonging to the decreasing class versus the low stable class. In addition, a high level of education (Bachelor's degree or higher) was significantly associated with a lower likelihood of belonging to the increasing class versus the low stable class (OR = 0.36, 95% CI [0.21, 0.63], $p < .001$), while a previous miscarriage was related to a higher likelihood of belonging to the increasing class versus the low stable class (OR = 2.07, 95% CI [1.19,

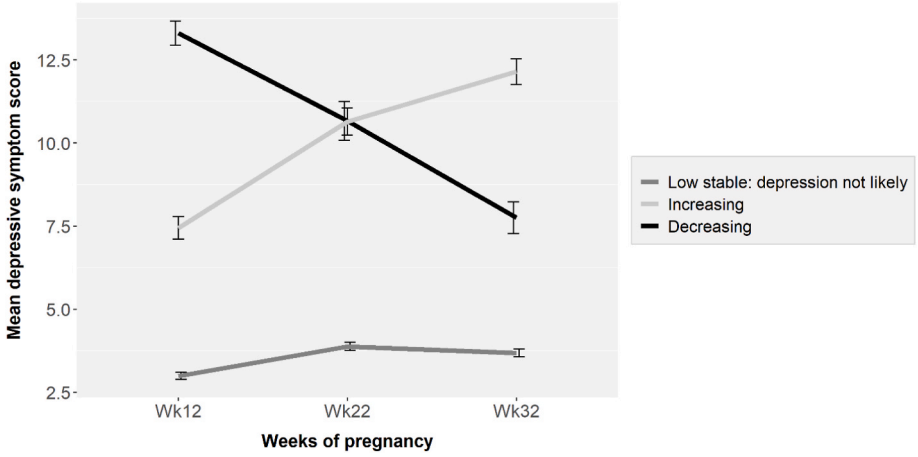

Fig. 1. Longitudinal trajectories (classes) of depressive symptoms during pregnancy (N = 762).

Table 2
Comparison between three trajectories of depressive symptoms during pregnancy (N = 762).

	Low stable N = 607 (79.7%)		Decreasing N = 74 (9.7%)		Increasing N = 81 (10.6%)		*p*-value	
	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	X^2	ANOVA *F*
Demographics								
Age		30.4 (3.5)		29.4 (3.7)		29.9 (3.8)		.059
High level of education	418 (68.9)		48 (64.9)		37 (45.7)		**<.001**	
Employment	560 (92.3)		63 (85.1)		69 (85.2)		**.024**	
Living with partner	603 (99.3)		69 (93.2)		79 (97.5)		**.001**	
Lifestyle habits								
BMI (pre-pregnancy)		23.6 (3.8)		24.3 (4.8)		24.0 (4.4)		.341
Smoking during pregnancy	24 (4.0)		3 (4.1)		8 (9.9)		.056	
Alcohol during pregnancy	25 (4.1)		4 (5.4)		6 (7.4)		.389	
Obstetrics								
Multiparity	285 (47.0)		33 (44.6)		42 (51.9)		.632	
Previous miscarriage	**136 (22.4)**		**25 (33.8)**		**27 (33.3)**		**.016**	
Unplanned pregnancy	31 (5.1)		6 (8.1)		4 (4.9)		.576	
Psychological features								
Previous depression	69 (11.4)		23 (31.1)		16 (19.8)		**<.001**	
TFMQ-SF at 22 weeks								
Acting with awareness		14.9 (3.1)		12.5 (2.5)		13.2 (3.1)		**<.001**
Non-judging		16.8 (2.9)		13.6 (3.0)		13.8 (3.0)		**<.001**
Non-reacting		11.6 (4.4)		12.2 (2.7)		11.1 (2.7)		.270

SD, standard deviation; high level of education, Bachelor's degree or higher; TFMQ-SF, Three Facet Mindfulness Questionnaire-Short Form; X^2, chi-square test; *F*, one-way ANOVA.
Bold: significance as defined by $p < .05$.

2.62], $p = .010$).

4. Discussion

The current study showed that facets of trait mindfulness were associated with different trajectories of depressive symptoms during pregnancy after adjustment for confounders. In the definition of mindfulness by Brown and Ryan (2003), not only attention to present-moment experiences (including thoughts and feelings) is recognized as essential, but also the quality of attention, namely an inner attitude of non-judgment and acceptance. This study showed that these different facets (acting with awareness, non-reacting and non-judging) indeed were associated with persistently lower levels of depressive symptoms during pregnancy.

Women with higher scores on acting with awareness and non-judging were less likely to belong to the class with decreasing levels of depressive symptoms throughout pregnancy. Although the levels of depressive symptoms decreased during pregnancy in this class, they remained significantly higher compared to the low stable class. Our results suggest that acting with awareness and non-judging could be significant in 'protecting' against higher levels of depressive symptoms during pregnancy. This is in line with the results of a study in which the validity of the Five Facet Mindfulness Questionnaire (FFMQ) in a group of 857 pregnant women was tested (Kantrowitz-Gordon, 2018). In this study, it was shown that the mindfulness facets acting with awareness and non-judging showed the strongest negative correlations with depressive symptoms.

Women with higher *non-judging* scores were less likely to belong to the class with increasing levels of depressive symptoms compared to women with similar higher scores on the *other two facets* of mindfulness. With every unit increase in non-judging scores, women were 28% less likely to belong to the increasing class, while with every unit increase in acting with awareness or non-reacting scores, women were 12% (acting with awareness) or 11% (non-reacting) less likely to belong to the increasing class. This implies that the association of non-judging was more pronounced for the increasing class. This suggests that especially non-judging could be a 'protective' factor during pregnancy not only against heightened levels of depressive symptoms, but also preventing the depressive symptoms to increase in those women who already present high levels during early pregnancy. Non-judging can be described

Table 3
Multinomial logistic regression with trajectories of depressive symptoms during pregnancy as the dependent variable (N = 762).

	Decreasing vs. Low stable			Increasing vs. Low stable		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
TFMQ-SF: Acting with awareness	0.81	[0.73, 0.90]	**<.001**	0.88	[0.80, 0.97]	**.009**
TFMQ-SF: Non-judging	0.77	[0.70, 0.84]	**<.001**	0.72	[0.65, 0.79]	**<.001**
TFMQ-SF: Non-reacting	0.96	[0.87, 1.04]	.333	0.89	[0.82, 0.97]	**.007**
High level of education	0.82	[0.45, 1.50]	.523	0.36	[0.21, 0.63]	**<.001**
Employment	0.51	[0.23, 1.13]	.098	0.52	[0.24, 1.12]	.096
Living with partner	0.19	[0.03, 1.15]	.071	0.93	[0.11, 7.53]	.943
Previous miscarriage	2.10	[1.17, 3.76]	**.013**	2.07	[1.19, 2.62]	**.010**
Previous depression	2.46	[1.32, 4.61]	**.005**	1.39	[0.71, 2.71]	.339

TFMQ-SF, Three Facet Mindfulness Questionnaire-Short Form; high level of education, Bachelor's degree or higher; OR, Odds Ratio; CI, Confidence Interval. **Bold**: significance as defined by $p < .05$.

as the ability to accept thoughts and feelings without self-judgment (Brown and Ryan, 2003). This inner attitude of acceptance has been shown to be an important factor in stress reduction (Chin et al., 2019; Lindsay and Creswell, 2017), which emphasizes the importance of non-judging in protecting against an increase in depressive symptomatology.

Although the association was less apparent, our findings suggest that acting with awareness and non-reacting may have the ability to 'protect' against a further increase in depressive symptoms as well. Acting with awareness means being present in experiences that happen in the current moment, rather than acting according to automatic patterns (Brown and Ryan, 2003). It could be speculated that pregnant women who have the ability to be attentive to present moment experiences, find more joy in the little things that make a pregnancy special, such as feeling the baby kick, seeing the ultrasound images and preparing the nursery. Fully experiencing these moments of happiness may help against an increase in depressive symptoms throughout pregnancy. Non-reacting indicates a capability to detach from, and not react to, negative thoughts and feelings. Non-reacting is related to the concept of decentering, which is "the capacity to shift experiential perspective, from within one's subjective experience onto that experience" (Bernstein et al., 2015). Decentering may play a crucial role in mental health (Brown et al., 2015), and it has been suggested that decentering may be especially relevant for pregnant women who are at risk for depression, because for many women, the sociocultural context of pregnancy and being a mother includes criticism from internal and external sources (Metcalf, 2019). The predictive negative association between non-reacting and depressive symptoms, and between acting with awareness and depressive symptoms, was also found in a meta-analysis on predictive associations between mindfulness facets and depression and anxiety in adults (Prieto-Fidalgo et al., 2022). In this meta-analysis, non-judging was found to covary with depressive symptoms, but did not predict decreasing depressive symptoms in adults (Prieto-Fidalgo et al., 2022). The current study findings seem to suggest that the relative importance of the mindfulness facet non-judging seems to grow in importance during pregnancy as compared to the two facets that seem to protect from symptoms of depression during other periods of life, namely acting with awareness and non-reacting.

With regard to the confounding variables, our results showed that women with a previous episode of a depression were more likely to belong to the decreasing class. This finding is not surprising since history of depression is a well-known risk factor for enhanced levels of depressive symptoms during pregnancy (Biaggi et al., 2016; Martini et al., 2015). Although there were more women with a previous episode of a depression in the increasing class (19.8%) compared to the low stable class (11.4%), we did not find a significant difference between these classes. This suggests that a history of depression is related to enhanced depressive symptom levels during pregnancy, but may not necessarily be associated with an increase in depressive symptom levels during the course of pregnancy. On the other hand, our findings showed that women with a high level of education were less likely to belong to the increasing class, while no significant difference was found between the decreasing class and the low stable class. The negative association between high level of education and depressive symptoms during pregnancy has been reported before (Biaggi et al., 2016; Martini et al., 2015). Our results imply that a high level of education may be especially important in 'protecting' against an increase in depressive symptoms during pregnancy. Moreover, women with a previous miscarriage were found to be more likely to belong to the decreasing *and* increasing class, which is in line with previous research that reported an association of history of pregnancy loss, pregnancy terminations and stillbirth with enhanced depressive symptoms during pregnancy (Biaggi et al., 2016).

The results of the current study indicate that pregnant women who score high on the mindfulness facets acting with awareness, non-judging and non-reacting may experience fewer symptoms of depression throughout pregnancy. These findings are in line with previous studies that have also demonstrated an association between (distinct facets of) trait mindfulness and depressive symptoms, both in non-pregnant and in pregnant populations (Branstrom et al., 2011; Cash and Whittingham, 2010; Krusche et al., 2019; Nyklíček et al., 2015). For example, a cross-sectional study among 363 pregnant women (12.9% first trimester, 76.6% second trimester, 10.5% third trimester) found a significant correlation between trait mindfulness and depressive symptoms (Krusche et al., 2019). These findings by Krusche et al. (2019) highlight the importance of trait mindfulness as a possible protective factor against depressive symptoms during pregnancy, even though this study only assessed mindfulness as a unidimensional construct. Furthermore, it is important to note that the findings of other studies that assessed the association between specific facets of mindfulness in relation to depressive symptoms are inconsistent across studies with regard to the facets non-judging and non-reacting. For example, a cross-sectional study in a non-pregnant population ($N = 1000$) found a significant association of acting with awareness and non-reacting with depressive symptoms, but in contrast with the current study findings, did not find an association of non-judging and depressive symptoms (Branstrom et al., 2011). Another cross-sectional study (non-pregnant population, $N = 106$) reported a significant association of both non-judging and acting with awareness with depressive symptoms (Cash and Whittingham, 2010), but failed to find an association between non-reacting and depressive symptoms, which is also in contrast with our results. Therefore, being attentive to the present moment (acting with awareness) seems to be important in experiencing fewer depressive symptoms, while findings regarding the association with non-judging and non-reacting are more inconsistent. These inconsistent findings are possibly explained by differences in the populations studied (non-pregnant vs. pregnant populations) and the study design. While these previous studies used a cross-sectional design, the current study assessed depressive symptoms at three trimesters of pregnancy to account for the high variability in (individual) depressive symptoms over time.

Strengths of the current study include the large sample size ($N = 762$) and the measurement of depressive symptoms at each trimester of pregnancy, which enabled us to estimate longitudinal trajectories by means of growth mixture modeling. A limitation is the self-report measurement of trait mindfulness and depressive symptoms during pregnancy. Particularly in mindfulness assessment, self-report measurement could induce bias through social desirability and personal values (Bergomi et al., 2013). Moreover, the single assessment of

mindfulness during this study (only at 22 weeks of pregnancy) is a limitation. Although mindfulness is assumed to be stable across six months (Jensen et al., 2016, 2019), it cannot be ruled out that the different events during pregnancy may influence the extent of being mindful. Future research could study the stability of mindfulness during pregnancy. In a longitudinal study on mindfulness and depressive symptoms during pregnancy, it would also be possible to study a possible bidirectional relationship between mindfulness and depressive symptoms in this specific period of life (Gómez-Odriozola and Calvete, 2020; Raphiphatthana et al., 2016; Snippe et al., 2015). Another limitation is that the current sample mainly included Dutch and white women, who were more often highly educated. This may limit the generalizability of the results. Future studies should address women with more diverse ethnic backgrounds.

5. Conclusion

The current study is among the first to show that the trait mindfulness facets acting with awareness, non-judging and non-reacting were associated with trajectories of depressive symptoms during pregnancy. Both acting with awareness and non-judging may protect against enhanced levels of depressive symptomatology during pregnancy. Especially non-judging and to a lesser extent the facets acting with awareness and non-reacting may serve as a buffer against an increase in depressive symptoms throughout pregnancy. Mindfulness-based programs may be beneficial for pregnant women with heightened levels of depressive symptoms, in order to practice state mindfulness (focusing on awareness of present-moment experiences, on detachment from negative thoughts and feelings, and especially on developing a non-judgmental inner attitude), and thereby strengthen trait mindfulness over time (Kiken et al., 2015). Previous studies showed positive effects of mindfulness-based programs on the mindfulness facets acting with awareness, non-judging and non-reacting (Duncan and Bardacke, 2010; Muzik et al., 2012; Perez-Blasco et al., 2013; Woolhouse et al., 2014). Moreover, promising positive effects of these programs on maternal distress have been reported (Dhillon et al., 2017). Future trials with sufficient power should further explore the effectiveness of mindfulness-based interventions in pregnant women (Hulsbosch et al., 2020).

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Author contributions

Lianne Hulsbosch: Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Visualization. Myrthe Boekhorst: Methodology, Validation, Investigation, Writing - Review & Editing. Joyce Endendijk: Formal analysis, Writing - Review & Editing. Ivan Nyklíček: Writing - Review & Editing. Eva Potharst: Writing - Review & Editing. Victor Pop: Conceptualization, Methodology, Investigation, Writing - Review & Editing, Supervision.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2022.04.023.

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