Original Article

Maternal Well-Being in Pregnancy and Breastfeeding Practices: Findings from the ROLO Study

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Abstract

Objective   Low mood is common during the perinatal period, which may negatively impact breastfeeding practices. Exploring predictors of successful breastfeeding is a health priority area. This study investigated if maternal well-being during pregnancy is associated with breastfeeding practices.

Study Design   This is a secondary analysis of a randomized control trial of a low glycemic index diet in pregnancy. A total of 610 secundigravida women were recruited in the National Maternity Hospital, Dublin, Ireland. Data on maternal education attainment, early pregnancy body mass index (BMI), and age were collected from hospital records. Well-being was self-reported by mothers between 10 and 28 weeks' gestation using the World Health Organization 5-Item well-being index. Scores were transformed to give percentage well-being. Mothers recorded breastfeeding practices at hospital discharge and at the study follow-up appointments. Chi-squares and independent t-tests determined initial differences in breastfeeding practices. Multiple and logistic regression analyses were used to adjust for confounders.

Results   Average maternal age was 32.7 years; average BMI was 26.6 kg/m^2, and 56% had achieved third-level education. The average well-being score was 58.2%. In unadjusted analysis, high well-being scores were associated with exclusive breastfeeding (56.2% breastfed vs. 46%, breastfed $p < 0.03$). After adjusted analysis, these associations were no longer significant (odds ratio: 1.00, 95% confidence interval: 0.99–1.01). No other associations were found.

Conclusion   Our findings indicated 25% of pregnant women in the first trimester reported low well-being scores. Associations between maternal well-being and breastfeeding patterns were explained by maternal age and education level, suggesting low mood may not be a barrier to breastfeeding initiation or duration. This trial is registered at: https://www.isrctn.com/ *ISRCTN54392969*.

Keywords
► breastfeeding
► well-being
► pregnancy
► mental health
► lactation

Key Points

- Well-being during pregnancy is often diminished and the WHO 5-Item well-being index is a useful measure in clinical settings to assess maternal well-being.
- Breastfeeding is a high-priority research area, particularly in an Irish setting.
- Well-being was not related to breastfeeding, however age, BMI and education were the main predictors of low well-being during pregnancy.

Mental well-being can be as important as physical state when determining an individual's health status.[1] Pregnancy is a time of significant change and growth for women, often leading to decreased well-being, coinciding with heightened levels of stress and anxiety.[2] Mental health has recently been presented in the literature as also playing a role in offspring health outcomes.[3] A plethora of research has examined variables contributing to depression in pregnancy such as high body mass index (BMI), low socioeconomic status, and low physical activity levels.[2] Well-being measures are capable of identifying individuals at risk of depression and could assist in highlighting individuals in need of extra care for their mental health.

The World Health Organization 5-Item Well-being index (WHO-5 index) identifies those at risk of depression and is applicable to multiple populations.[4] Screening maternal well-being in early pregnancy may allow detection of women at the greatest risk of depression allowing for intervention, improved mood, and consequently reduced risk of depression and adverse pregnancy outcomes.

Breastfeeding provides optimum nutrition to support infant development.[5,6] Breastfeeding rates vary depending on countries, with some countries showing very low rates. In Ireland, as few as 58% of infants receive breastmilk at birth, and this decreases to 35% of infants receiving some breastmilk 3 months' postpartum.[7] By 6 months' postpartum, as few as one in four infants are still breastfed, despite this being the global recommendation by the WHO.[8] Research into the factors associated with initiation and maintenance of breastfeeding is of critical importance in prioritizing and influencing public health.

Majority of existing literature focuses on the bidirectional relationship of postpartum mental health and breastfeeding habits.[9] While some studies have investigated prenatal depression and breastfeeding, few have investigated well-being using the WHO-5 index. Primarily, the Edinburgh Postnatal Depression Scale (EPDS) has been used for prenatal depression, despite it being specifically designed for the postpartum period. Increased scores during pregnancy in the EPDS has been previously associated with lower breastfeeding intention.[10,11] Furthermore, the EPDS has been associated with lower duration.[12,13] The Centre for Epidemiologic Studies Depression Scale (CES-D) has been associated with decreased breastfeeding duration.[14–16] Well-being is less specific than the EPDS or the CES-D, hence may be capable in capturing more women at risk of depression allowing for earlier intervention.

There is a clear paucity of data investigating the association of maternal well-being in early pregnancy, as measured using the universal WHO-5 index, with breastfeeding prac-

tices. During pregnancy, it has been found that the highest rates of depressive symptoms occur within the first trimester.[17] Considering the importance of breastfeeding and the WHO-5 index being an effective screening tool for those at risk of depression, this research aimed to determine if an association exists between scores in early pregnancy and later breastfeeding practices. It is hypothesized that low well-being scores will be associated with lower breastfeeding rates and earlier discontinuation of breastfeeding.

Materials and Methods

The ROLO Study

This is a secondary analysis of the longitudinal ROLO Study; originally a randomized control trial (RCT) of a low glycemic index (GI) diet during pregnancy to prevent recurrence of macrosomia (birth weight $\geq$ 4 kg) in euglycemic women. Ethical approval was granted by the National Maternity Hospital in November 2006; the trial was performed in accordance with the Helsinki Declaration of Human Rights 1975 (revised in 1983). The ROLO study took place from 2007 to 2011 in the National Maternity Hospital, Dublin, Ireland. Methods and primary outcome of this study has been previously published.[18] In summary, 751 secundigravida women having previously given birth to an infant with macrosomia with no current or previous diagnosis of diabetes were recruited. Women were randomly assigned to usual care or to receive dietary advice on a low GI diet to follow throughout pregnancy. The primary aim was to determine if the low GI diet resulted in lower birth weight as these infants were at greater risk of macrosomia. While this was not observed, women in the intervention group gained less weight throughout the pregnancy and lost weight postpregnancy at a faster rate than those in the control group.[18] The women and children involved in the study then took part in the longitudinal follow-up studies at 6 months', 2 years', and 5 years' postpartum. As such, this analysis is a retrospective analysis as the WHO-5 well-being index was collected in early pregnancy and women reported breastfeeding habits at each follow-up. Participants were included in this analysis if they had answered the WHO-5 well-being questionnaire and had reported breastfeeding initiation and duration at some point ($n = 610$).

Data Collection

Maternal Well-Being

In early pregnancy (mean gestation: 12.8 ± 2.2 weeks), women were asked to complete the WHO-5 index and return to

the research team by 28 weeks' gestation. This questionnaire is used globally to determine mental well-being, it is highly specific and validated,[4] and its global use allows for comparisons between countries. It has strong clinometric value and is regularly used as a screening tool for depression and as RCT outcome measures. It is a self-reported, 6-point Likert scale questionnaire, asking questions such as "I have felt cheerful and in good spirits," "I have felt calm and relaxed," "I have felt active and vigorous," "I woke up feeling fresh and rested," "My daily life has been filled with things that interest me" during the previous 2 weeks. Participants answered the question using the following scale: "all of the time" (5), "most of the time" (4), "more than half the time" (3), "less than half the time" (2), "some of the time" (1), "at no time" (0). Maximum score is 25, indicating the highest possible well-being. Raw scores are multiplied by 4 to give a percentage score. The cohort was also dichotomized into those that had high well-being scores ($\geq 50\%$) and low well-being scores ($<50\%$). This has previously been shown to accurately categorize patients.[4,19] The Cronbach-α for the WHO-5 index is 0.802, indicating good internal validity.

Breastfeeding

The ROLO longitudinal study consisted of numerous follow ups: birth, 3 months, 6 months, 2 years, and 5 years of postnatal. At each time point, participants were asked if they had ever breastfed their study child, and if yes, for how long. A composite of the answers given across the follow-ups was created and used for this analysis. Participants that returned at the earliest follow up of 6 months had this report of breastfeeding practices used. If a participant did not return at 6 months but did at 2 years, this was used and cross-checked with hospital records. Similarly, if the soonest follow-up was at 5 years, this measure was used.

Confounders

Further data were collected on maternal BMI (kg/m^2), education level (education from a higher education institute; universities, institutes of technology, and colleges of education), RCT intervention group, smoking status during pregnancy (yes or no), and ethnicity (Caucasian or other). These details were collected during pregnancy alongside the WHO-5 well-being index. Infant birthweight and sex was obtained from hospital records at time of birth.

Statistical Analysis

All continuous variables were checked for normality using histograms as visual aids. Breastfeeding duration was not normally distributed and so transformed using $\log_{10}$ transformations. The transformed variable was confirmed as normally distributed and used in analysis. Differences between high or low well-being groups were determined for participant characteristics using chi-squares for categorical variables (education, RCT group, breastfeeding initiation) and independent sample t-tests were used for continuous variables (maternal age, BMI, and well-being percentage score). As breastfeeding duration was nonparametric, the median and interquartile range (IQR) are reported, and

Mann–Whitney U testing was used. Multivariate logistic regression was used to assess associations between well-being scores and breastfeeding initiation and exclusivity, adjusting for RCT group, maternal age at delivery, BMI, and education level. As part of logistic regression, the Wald scores were determined as the value of the statistic for each predictor, i.e., how important the variable is for predicting the outcome. Multivariate regression analysis was used to investigate the associations between well-being as a percentage score and duration, and exclusivity, controlled for the aforementioned variables. Significance was set at $p < 0.05$.

Results

Characteristics of the cohort are reported in ►Table 1, displayed as total group, and separately reported for participants with high well-being scores ($\geq 50\%$) and with low well-being scores ($<50\%$). p-Values depict significance of differences between each group. For the total group, average age was 32.7 years, average BMI was 26.6 kg/m^2, which is in the overweight category, 56% of the population had obtained third-level education, and less than 5% were smokers. The average infant birth weight was 4.1 kg. The average well-being score was 58.3%. A total of 163 women (26.7%) reported a low well-being score. The average well-being score in the high well-being group was 65.6%, and in the low well-being group was 38.01%. The minimum well-being score was 4% and maximum was 100%. Comparing high and low well-being groups, those reporting a higher well-being score were older, average age was 33 versus 32 years ($p = 0.027$) and 60.2% compared with 44.2% had third-level education ($p < 0.001$). There was a trend toward those in the intervention group having a lower well-being score. When investigated using independent t-test with well-being percentage score as a continuous variable, the difference was significant, however only by 4%, which equates to 1 point (14.05 vs. 15.05, $p < 0.001$).

In the total cohort, 377 women (61.8%) breastfed, and median duration was 17.33 weeks (IQR: 30.33). There were 326 women that exclusively breastfed (53.4% of all women, 86.47% of those that breastfed at all). A total of 36 women both breast and formula fed (5.9%) and 248 women formula fed exclusively (40.7%). Breastfeeding practices between well-being groups can be seen in ►Fig. 1. There was a significant difference in the percentage of women that exclusively breastfed comparing high and low well-being groups (56.2% in high well-being vs. 46.0% in low well-being, $p = 0.026$). No other groups were significantly different; however, trends indicating lower well-being to be associated with initiation of breastfeeding were identified ($n = 64.0\%$ vs. $n = 55.8\%$, $p = 0.067$) and formula feeding methods ($n = 38.5\%$ vs. $n = 46.6\%$, $p = 0.07$) in high versus low well-being groups, respectively. There was no association of well-being with mixed feeding (5.4 vs. 7.4%, $p = 0.355$) or duration (17.3 vs. 20 weeks, $p = 0.497$) in high versus low well-being groups, respectively.

►Table 2 reports logistic regression models investigating the effect of well-being on breastfeeding initiation, and

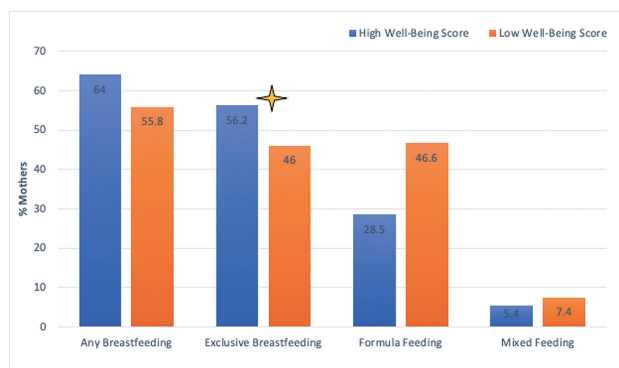**Table 1** Characteristics of ROLO participants included in this analysis

	Total group (n = 610)	High well-being (n = 447; 73.3%)	Low well-being (n = 163; 26.7%)	p
Age at delivery (y)	32.7 ± 4.0	32.9 ± 3.9	32.1 ± 4.3	0.027
BMI (kg/m^2)	26.6 ± 4.8	26.4 ± 4.6	27.0 ± 5.7	0.189
Third-level education	341 (55.9)	269 (60.2)	72 (44.2)	<0.001
RCT group intervention	297 (48.7)	208 (46.5)	89 (54.60)	0.078
Smoking pregnancy	29 (4.8)	19 (4.3)	10 (6.10)	0.226
Ethnicity—Caucasian	548 (89.8)	402 (89.9)	146 (89.6)	0.880
Infant birth weight (kg)	4.05 ± 0.5	4,046.0 ± 467.0	4,046.35 ± 476.7	0.933
Well-being (WHO-5 index)				
Percentage score	58.3 ± 15.4	65.6 ± 9.1	38.01 ± 9.8	<0.001
Feeding practices				
Breastfeeding duration	17.3 [30.3]	17.33 [28.7]	20.00 [37.0]	0.497

Abbreviations: BMI, body mass index; education, achieved education from a higher education institute (universities, institutes of technology, and colleges of education); RCT, randomized control trial; ROLO, randomized control trial of a low glycemic index diet in euglycemic women[18] WHO-5, World Health Organization 5-Item.
Notes: Results presented as mean + standard deviation, median [interquartile range], or n (%). Chi-squares and independent sample t-tests used to determine p-values, significant set at p < 0.05.

exclusive breastfeeding, adjusting for confounders. The Wald test determined the value of the statistic for each predictor of both outcomes. The Wald values in predicting breastfeeding initiation were: well-being 0.024, BMI 4.633, age 9.020, third-level education was 50.523, and RCT intervention group was 0.194. The Wald values in predicting exclusive breastfeeding were: well-being 0.165, BMI 9.298, age 7.461, and third-level education was 35.683. Further details on odds ratios and significance for the logistic regressions are reported in ►Table 2.

►Table 3 shows adjusted association between well-being as a percentage score and breastfeeding duration in weeks. Overall, the model was a significant predictor for breastfeeding duration; however, well-being had no association with duration of breastfeeding.

Table 2 Logistic regression models with breastfeeding initiation and breastfeeding exclusivity predicted by the World Health Organization 5-Item well-being score

	Odds ratio	95% Confidence interval	p
Model for breastfeeding initiation			
Well-being score	1.001	0.989, 1.013	0.878
BMI (kg/m^2)	0.960	0.925, 0.996	0.031
Age (y)	1.071	1.024, 1.121	0.003
Third-level education	3.717	2.588, 5.338	<0.001
RCT group	1.082	0.759, 1.547	0.660
Model for breastfeeding exclusivity			
Well-being score	1.002	0.992, 1.014	0.684
BMI (kg/m^2)	0.944	0.909, 0.980	0.002
Age (y)	1.062	1.017, 1.110	0.006
Third-level education	2.903	2.047, 4.118	<0.001
RCT group	1.045	0.742, 1.470	0.802

Abbreviations: BMI, body mass index; third-level education, achieved education from a higher education institute (universities, institutes of technology, and colleges of education); RCT; randomized control trial intervention group.
Notes: p-Value significance set at p < 0.05. Well-being score from World Health Organization 5-Item Index (The WHO-5 Web site).

Fig. 1 Difference in breastfeeding practices between well-being groups of high (>50%) and low (<50%) well-being. Well-being measured using the World Health Organization 5-Item well-being index. Differences determined using chi-square tests. Significant difference found in well-being scores among those that exclusively breastfed. *Significant p-value < 0.05.

Discussion

Our results did not identify an independent association between maternal self-assessed well-being in early pregnancy, as measured by the WHO-5 well-being index, and subsequent breastfeeding practices, including initiation and duration. Some weak associations between exclusive

Table 3 Multiple regression model with breastfeeding duration (weeks) as the outcome variable, predicted by the World Health Organization 5-Item well-being index and adjusted for confounders

	B	p	95% confidence interval	R^2 Adj.	p
Model for breastfeeding duration					
Well-being score	0.003	0.304	−0.003, 0.008	0.072	0.001
BMI (kg/m^2)	−0.015	0.089	−0.033, 0.002		
Age (y)	0.012	0.274	−0.009, 0.033		
Third-level education	0.286	0.001	0.111, 0.461		
RCT group	0.041	0.633	−0.126, 0.208		

Abbreviations: BMI, body mass index; third-level education, achieved education from a higher education institute (universities, institutes of technology, and colleges of education); RCT group, randomized control trial intervention group.
Notes: Significant $p < 0.05$, determined using multiple regression models. Well-being score determined using the World Health Organization 5-Item Index (The WHO-5 Web site, no date).

breastfeeding and well-being scores were identified, which may be explained by differences in maternal age and education level. These findings did not indicate that maternal self-reported well-being status in early pregnancy represents an exclusive barrier to successful breastfeeding.

With respect to our findings, we report that pregnancy is a time of poor well-being, potentially due to the physical changes, hormonal changes, stress, and anxiety that often comes with pregnancy, as 26.7% of our population reported a low well-being score. It was previously found that 16% of women in the antenatal period had depression as measured using the EPDS in Ireland.[20] Rates of depression reach as high as 20% in some American populations.[21,22] The discrepancy between our results and those of Jairaj et al can be explained by the specificity of the EPDS in diagnosing depression, compared with the broader categorization of the WHO-5 index. The DALI study noted 27% of 735 pregnant women were classified as having a well-being score below 50%,[19] comparable to our own findings. The EWE study did not categorize results but reported a mean well-being score of 60.5% using the WHO-5 index among pregnant women.[23] Mortazavi et al evaluated WHO-5 scores in Iranian pregnant women and also found a mean score of 58% (2015).[24] It is clear that a significant number of women during pregnancy are at an increased risk and may require additional support during this time. As the WHO-5 index measures risk of depression it can be useful for identifying a population that could benefit from an intervention to improve daily well-being, which may subsequently reduce the numbers of women with antenatal depression. When looking at breastfeeding rates, however, the WHO-5 may not be useful in identifying those who may benefit from additional support.

There is a paucity of research examining how maternal well-being may influence breastfeeding practices and the research that exists is equivocal. Our goal was to determine if a potential relationship exists between early pregnancy well-being and breastfeeding. The reasoning behind this stems from the knowledge that well-being is often reduced during pregnancy, and maternal self-assessed well-being levels has to be investigated in relation to predicting breastfeeding habits. In addition, the WHO-5 well-being index has demonstrated its suitability for use in a pregnant population and a

clinical setting due to its simplicity. It holds great potential for being incorporated into standard antenatal clinical care if capable in predicting outcomes of interest. However, we noted no ability of this tool to predict breastfeeding habits. Our results suggest there is greater opportunity to improve breastfeeding outcomes by targeting BMI and education. Age is also a factor of consideration although offers less room for intervention.

In line with our results, Haga et al examined over 1,200 women, in which 61% exclusively breastfed and 22% did not breastfeed at all.[25] This longitudinal research found no associations between depression and breastfeeding in a Norwegian cohort.[25] Other research has also corroborated these findings.[26,27] Comparatively, we expected an association between women at risk of depression and breastfeeding rate, but this was not founded. As an Irish cohort, we have less successful breastfeeding rates than Norway, and this highlights the need to identify opportunities to improve breastfeeding. Time point should be considered going forward as there was a difference in time points of measurement as women were recruited in their third trimester and assessed for depression in the above studies, where as our analysis represented early pregnancy. Interestingly, Fairlie et al using data from Project Viva, found 9% to have antenatal depression as measured using the EPDS, with a breastfeeding initiation rate of 86%.[10] While they assert that prenatal anxiety was associated with intention to formula feed as opposed to breastfeed, they did not find prenatal anxiety and pregnancy related stress to be associated with incidence of breastfeeding. We used a broader questionnaire in assessing well-being and did not examine intentions around breastfeeding. However, our findings were similar in demonstrating a lack of association between breastfeeding and well-being, further suggesting that age, BMI, and education are the most important factors in predicting positive breastfeeding habits.

The lack of a strong association between well-being and breastfeeding practices in our specific study may be resulting from residual confounders rather than a lack of a relationship. All participants are secundigravida mothers, i.e., this is there second pregnancy, and therefore may be inclined to proceed in this pregnancy as they did with their first child. Well-being may be more evident as a predictor of

breastfeeding in first-time mothers. Education appeared as a strong predictor, as did BMI. Our cohort is characterized as being well-educated but with a slightly elevated BMI on average. Well-being may be more applicable in more normative groups or in interventions powered to predict breastfeeding habits. Well-being has previously been reported as being lower in the study intervention groups[28]; however, this was controlled for in adjusted analysis. Well-being still holds significance in predicting other pregnancy outcomes and the WHO-5 scale may still be a useful tool to introduce to clinical routine.

This study has several strengths including the use of the WHO-5 index, which is a widely used, validated measure of well-being for use as a clinical outcome, and this investigation is the first of its kind in an Irish population. The study involved a large cohort that was very well characterized to allow investigation into both breastfeeding initiation and duration. Recording well-being in early pregnancy was a novel approach, strengthening the study, as it would allow time for intervention throughout pregnancy to improve well-being in individuals. Furthermore, early pregnancy is considered the time at which low well-being is most common. We recognize there are marked limitations to this study. It must be noted that the WHO-5 index is a self-reported score; however, this is also beneficial to allow a comparison between self-rated well-being and a mother's decision to breastfeed. All breastfeeding data are self-reported; however, the use of the composite value reduced memory bias in relation to breastfeeding duration. It also must be noted that this study was not designed to predict breastfeeding habits by well-being or any other factor during pregnancy, as this is a secondary analysis, it is not powered nor designed to do so and may not be capable of predicting such sensitive relationships.

Conclusion

This research adds to the ongoing discussion surrounding well-being and breastfeeding practices and deduces that low well-being scores in pregnancy are not a barrier to initiation or continuation of breastfeeding in this cohort. The inconsistency in the outputs of the literature remains an issue, requiring further research to clarify the true relationship. This is among the first studies to our knowledge to investigate those at risk of depression rather than those with depression, as it offered greater opportunity to intervene. As maternal well-being is known to be reduced during pregnancy, it is encouraging to have such findings, and this is important when supporting women with low mood to breastfeed. Future research in this area is warranted to continue to improve rates of breastfeeding and further explore the impact maternal mood and well-being may have.

Ethics Approval and Consent to Participate
Ethical approval was granted by the National Maternity Hospital in November 2006; the trial was performed in accordance with the Helsinki Declaration of Human Rights 1975 (revised in 1983). All participants provided informed, written consent.

Authors' Contributions
C.A.Y., A.A.G., E.C.O.B., E.L., and F.M.M. were involved in the conception and design of the study. A.A.G., E.C.O.B., E.L., and M.C. were involved in the acquisition of data. C.A.Y. performed all statistical analysis. C.A.Y., A.A.G., S.L.K., and F.M.M. were involved in the interpretation of the data. J.M. was responsible for the data management. C.A.Y. drafted the manuscript. All authors revised the work critically and approved the final manuscript.

Conflict of Interest
None declared.

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