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Perspectives

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Editorial

Christiana Rebelle, PhD, Editor-in-Chief

Welcome to the Spring 2025 issue of the *Journal of Prenatal and Perinatal Psychology and Health*. This edition presents timely, compelling research and reviews on maternal mental health, healthcare access, psychobiology, and history. The articles featured here deepen our understanding of how early experiences, environments, and medical practices have lifelong influences.

We begin with an examination of mothers' perceptions of the postpartum visit based on rural status. Thayagabalu et al. conducted a cross-sectional study comparing postpartum experiences and perceived visit benefits between rural and non-rural mothers in north-central Florida. The authors found that rural participants reported greater satisfaction with the information received, particularly regarding health services, physical recovery, and emotional health. These findings highlight opportunities for improving care across geographic settings and emphasize the need to address low postpartum visit attendance.

Pierpoint et al. turn our attention to postpartum depression, identifying key risk factors and evaluating the use of a telehealth appointment at three weeks postpartum. Their findings highlight significant associations between higher Edinburgh Postpartum Depression Scale (EPDS) scores and a history of mental health diagnoses, particularly among Black patients. The addition of a telehealth visit did not appear to reduce EPDS scores, suggesting that further strategies are needed to support maternal mental health following childbirth.

In a novel contribution exploring prenatal aesthetics and emotional memory, Ruettner and colleagues analyze artwork created by individuals with somatoform pain disorders. Through psychoanalytic interpretation and grounded visual analysis, they describe recurring imagery that reflects distressing prenatal themes, including fragmentation and symbolic representations of containment. This work adds a unique perspective to the ongoing investigation of how early relational experiences may manifest in adulthood through psychological and somatic symptoms.

Lykkegaard et al. build on earlier work to present the second part of their theory of subcellular psychobiology. They propose that psychological trauma is the experiential result of epigenetically inhibited gene expression in the primary cell, and that expression can be restored using trauma therapies. The paper also discusses safety concerns regarding this line of research and previews the third part of the theory, which will be published in the next issue.

Lunsford contributes an overview of Neonatal Abstinence Syndrome (NAS), underscoring its growing prevalence and the urgent need for responsive care. Drawing on recent national data, the article reviews current interventions and offers suggestions for future approaches, particularly as opioid use in pregnancy remains underreported and often undertreated.

In "The Dirt on Hygiene," Steier et al. explore how public health responses to infectious disease evolved from early microbial discovery to modern antimicrobial overuse. The authors reflect on the hygiene hypothesis and the possibility that reduced microbial exposure may be linked to chronic immune-related conditions. This historical narrative emphasizes the importance of accurate health communication, especially in light of recent attempts to discredit germ theory.

This issue concludes with my article, "From Eugenics to Evidence," tracing the history of prenatal physical activity guidelines and examining their influence on current maternal health outcomes. Long-standing medical caution and cultural norms have shaped perceptions of pregnancy and exercise, often leading to low participation rates and inconsistent provider guidance. This review calls for better alignment between evidence-based recommendations and clinical practice to improve health outcomes for mothers and babies.

We extend our heartfelt thanks to Mary Newman as she steps away from the *JOPPPAH* editorial board. Her contributions, thoughtful reviews, and boundless encouragement have been a gift to our team and the journal. We are deeply grateful for her insight, positivity, and dedication and wish her the best.

We are always looking to grow our board with thoughtful and passionate professionals. If you are interested in contributing to *JOPPPAH*, we invite you to send your CV to journal.editor@birthpsychology.com to be considered for a position on the editorial board. On behalf of the editorial team, I also want to thank our contributors, reviewers, and volunteers for their dedication to this work. Your efforts sustain the mission of *JOPPPAH* and continue to expand the reach of prenatal and perinatal psychology and health science.

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Cross-Sectional Study of Mothers' Perception of Postpartum Visit Benefit by Rural Status

Sionika Thayagabalu, Dominick J. Lemas, PhD, Stacy Wright, MPH, Bethsaida Lopez Gillum, MSN, Jessica S. Bahorski, PhD

The postpartum period is associated with a high prevalence of maternal mortality and morbidity, particularly among rural communities. This study aimed to identify differences in the perceived benefit of the postpartum visit among participants in rural and non-rural counties. This cross-sectional study recruited postpartum mothers from counties in north-central Florida. Participants completed an online survey focused on experiences during pregnancy, birth, and postpartum. Eligibility criteria included being at least 18 and giving birth to a healthy, full-term, singleton infant in the past year. Mann-Whitney U and Fisher's exact tests were used to compare the differences in mothers from rural versus non-rural counties. Participants (N = 91) lived in rural (n = 18) and non-rural counties (n = 73), and most attended the postpartum visit (93.8% of rural and 97.2% of non-rural participants). Rural participants reported higher scores in receiving information on

The authors have no conflict of interest. Sionika Thayagabalu (ORCID: 0009-0009-7754-0375) is affiliated with the Department of Health Outcomes and Bioinformatics, College of Medicine, University of Florida (UF). Dominick J. Lemas, PhD (ORCID: 0000-0001-5105-2458) is associated with the Department of Health Outcomes and Bioinformatics and the Department of Obstetrics and Gynecology, College of Medicine, UF. Stacy Wright, MPH, CHES is part of the Department of Health Outcomes and Bioinformatics, College of Medicine, UF. Bethsaida Lopez Gillum, MSN, APRN and Jessica S. Bahorski, PhD, APRN (ORCID: 0000-0002-2989-0188), are affiliated with the College of Nursing, Florida State University (FSU), Tallahassee, FL. This work was supported by the UF and FSU Clinical and Translational Science Award (CTSA) (UL1TR001427) HUB Pilot Award and the National Institute of Diabetes and Digestive and Kidney Diseases (K01DK115632). The content is solely the authors' responsibility. It does not necessarily represent the official views of FSU, the UF Clinical and Translational Science Institute, or the National Institutes of Health. The authors acknowledge the research teams at FSU and the UF who assisted with recruitment and data collection for this study. Please send correspondence to jbahorski@fsu.edu.

health services (4.24 vs. 3.6, $p = 0.02$), physical health (4.24 vs. 3.43, $p = 0.01$), and mood changes (3.71 vs. 3.21, $p = 0.14$) compared to non-rural participants. Rural participants perceived greater benefits from the postpartum visit than non-rural participants, highlighting the need to explore why attendance rates at this visit are often low for mothers from rural counties. These results support the need to restructure postpartum care to meet the needs of mothers from all areas and make policy changes to support mothers. Future research should explore the individual barriers and facilitators to postpartum care for those in rural versus non-rural areas.

Keywords: rurality, postpartum, perinatal care

Maternal and infant mortality rates in the United States are higher than in many other developed countries and have risen steadily over the past 30 years (Collier & Molina, 2019; Kassebaum et al., 2016). Maternal mortality signifies the death of a woman during pregnancy or within one year after birth related to the pregnancy (Hoyert, 2023). In 2021, there were 32.9 maternal deaths per 100,000 live births, nearly double the rate of 17.4 deaths per 100,000 live births in 2018 (Joseph et al., 2024). Trends in maternal mortality indicate that most maternal deaths now occur during the first year postpartum (Kassebaum et al., 2016). Moreover, infant mortality is defined as an infant's death prior to his or her first birthday. Infant mortality rates also remain high in the United States, with 5.6 deaths per 1,000 live births in 2022 (Centers for Disease Control and Prevention [CDC], 2024; Kassebaum et al., 2016). Maternal and infant mortality differences across race and geographic location highlight the health disparities in maternal-child health. Changes in support, education, and care during the perinatal period are needed to reduce these rates across all groups. Currently, one maternal visit at six weeks postpartum is the only recommended healthcare visit and is known to be insufficient in meeting maternal needs (Paladine et al., 2019). Thus, additional research is needed to understand the concerns and challenges for mother-infant dyads following birth to identify how to enhance care during the postpartum period (Admon et al., 2018; Oribhabor et al., 2020).

The *fourth trimester* is the period from birth to 12 weeks after birth and is a key time for intervention to address mother-infant needs (Paladine et al.,

2019; Tully et al., 2017). This period is a time of transition for mothers, infants, and families, and it is associated with many challenges and possible unmet healthcare needs. Maternal concerns during this time encompass several domains, such as physical complications from pregnancy (e.g., hypertensive disorders, gestational diabetes, incontinence), psychological difficulties (e.g., depression, anxiety, intimate partner violence), and social concerns (e.g., financial constraints, contraception, sexuality) (Kassebaum et al., 2016; Paladine et al., 2019; Tully et al., 2017). Mothers also experience the psychological stress of caring for a newborn who requires frequent feeding, is at risk for communicable diseases, and could suffer from inborn errors of metabolism or congenital heart defects (Tognasso et al., 2022). Ensuring adequate infant growth and development is essential to positive infant outcomes (Paladine et al., 2019; Tully et al., 2017).

Postpartum mothers living in rural areas have reduced access to healthcare, lower levels of health literacy, and high rates of poor health outcomes that include maternal and infant morbidity (Natarajan et al., 2023). Specifically, mothers from rural areas are less likely to attend medical visits in the postpartum period compared to mothers from urban areas (Bozkurt et al., 2024). The National Advisory Committee on Rural Health and Human Services provided a briefing titled "Maternal and Obstetrics Challenges in Rural America," which identified a need for comprehensive and integrative case management, refined safety and treatment guidelines in rural clinics, and a need to reduce the obstetrics workforce shortage in rural America (Colyer et al., 2020). Moreover, a study comparing rural and urban postpartum mothers found that rural mothers were less likely to attend postpartum medical visits and receive comprehensive postpartum screening and counseling (Bozkurt et al., 2024). Florida is the third largest state by population, with more than 200,000 deliveries annually across multiple health systems, and represents a diverse maternal population with variations in race, ethnicity, and geographic background (March of Dimes, 2025). Additionally, 32 of Florida's 67 counties are defined as rural, with 81% in the north-central regions of Florida (Florida Department of Health, 2023; Florida Legislature, 2025). Thus, focusing on rural populations is necessary to identify ways to intervene and improve maternal-child outcomes in Florida.

Given the known challenges and medical risks inherent to the fourth trimester, a single six-week postpartum visit is inadequate in addressing maternal health needs (American College of Obstetricians and Gynecologists

[ACOG], 2018; Walker et al., 2019). Postpartum visits often fail to address the unique postpartum needs identified by mothers, inadequately connect women with primary care services, and have low attendance (ACOG, 2018; Walker et al., 2019). It is also known that cultural or familial perceptions of postpartum care and patient-provider communication can inhibit attendance at the postpartum visit (Henderson et al., 2016). Recently, national organizations such as the ACOG have focused on restructuring postpartum care to reduce postpartum and long-term morbidity and improve well-being (ACOG, 2018; Firoz et al., 2018; Walker et al., 2019). This restructuring includes a focused assessment of the physical, social, and psychological well-being of new mothers via analysis of mood, infant feeding, sexuality, contraception, fatigue, physical tolls of birthing procedures, and chronic disease management. ACOG recommended that added policies should support postpartum care as a process rather than a singular visit with an obstetrician (ACOG, 2018). This study aimed to identify the perceived maternal benefit of the postpartum visit, specifically examining the differences between mothers from rural and non-rural counties. We hypothesized that fewer rural mothers would attend the postpartum visit compared to non-rural mothers due to lower perceived benefits from the visit.

Methods

This cross-sectional study recruited participants aged 18 or older who had given birth to a healthy, singleton, full-term ($\geq$37 weeks gestation) infant in the past year. Recruited participants had to live in north-central Florida in one of three cities (Gainesville, Jacksonville, and Tallahassee) or the surrounding counties. Participants were excluded if they were under 18 years old, gave birth to twins or multiples, or had an infant with a complex medical condition (e.g., congenital or genetic anomalies). In-person and online recruitment strategies that were linguistically and culturally appropriate were utilized for outreach, recruitment, and enrollment of participants in the study (Fam & Ferrante, 2018; Vaughan et al., 2022). This included providing flyers via postpartum and pediatric clinic visits, postnatal education classes, social media platforms, and word of mouth. Efforts were made to include diverse populations. Participants were recruited, and data was collected from August 2022 to July 2023. A one-time survey was completed with the option to complete a qualitative interview.

A total of 100 mothers were sought for the study to represent a diverse sample of postpartum mothers in the target area.

All recruitment material provided participants with a link to the one-time online survey to complete via the Research Electronic Data Capture (REDCap) platform. Paper surveys were available for participants with limited online access, although they were never requested. Demographic questions included maternal age, race, ethnicity, marital status, education level, and employment status. Additionally, the participants' zip code was collected to determine rurality status as defined by Florida. A questionnaire was developed to collect maternal perspectives on physical, psychological, and social aspects of pregnancy, birth, and the postpartum experience. The survey was developed based on existing literature and modeled after Sjetne and colleagues' (2015) questionnaire. The questionnaire was modified to be appropriate to a population in the United States. Once developed, it was reviewed by pediatric and obstetric clinicians and mothers who had recently given birth to confirm that the survey was valid and reliable.

The measure of social support was gathered via a questionnaire used in previous work by the Welfare Children Families (WCF) project (Radey, 2018). This 9-item questionnaire has three response options regarding the level of support: no one, some people, and enough people (Radey, 2018). Mothers reported depression via the Edinburgh Postnatal Depression Scale (EPDS) and body image perception via the Body Shape Questionnaire (BSQ)-8b. The EPDS analyzes emotional experiences over 7 days using 10 Likert-scale items that assess sadness, fear, loss of interest, anxiety, sleep, self-blame, and suicide ideation. Scores range between 0 and 30, with scores above 10 suggesting the need for in-depth depression evaluation (Atuhaire et al., 2023). The BSQ-8b is a questionnaire abbreviated from the full BSQ, which provides a self-reported assessment of body shape and body dysmorphia. The questionnaire has eight items with Likert-scale responses ranging from 1 (never) to 6 (always). The total score ranges from 8 to 48 points, with higher scores indicating greater concerns regarding body shape (Evans & Dolan, 1993; Yurtsever et al., 2022).

Mothers were compensated $20 for survey completion. After the online survey, participants were asked if they would be willing to participate in an in-depth interview to elaborate on their responses. A series of open-ended questions regarding the mothers' experience during the fourth trimester were asked, and the results were analyzed. The Institutional Review Boards at Florida State University and the University of Florida approved the study.

Data Analysis

The demographic characteristics of this sample were analyzed using descriptive techniques. All surveys were calculated as appropriate to each tool. Participants reported current (post-pregnancy) height and weight, from which a body-mass index score (BMI) was calculated. BMI categories were derived based on CDC guidelines for the United States (CDC, 2024). Baby age was calculated as the difference in days from the survey date and the baby's date of birth. Mothers reported infant birth weight in pounds and ounces, which was converted to kilograms (kg). Marital status was dichotomized into two groups: married or living as married and single.

Due to the limited diversity in race and education, groups were created based on what would provide the broadest representation of the sample. Three racial groups were created: White (Caucasian), Black (African American), or mixed (other). Three education groups were created: high school graduate or less than high school education, some college or vocational school, and a college graduate. Poverty status was based on the federal poverty level for 2023 by examining household income and the number of individuals living in the household (Department of Health and Human Services, n.d.). The variable was dichotomized into yes, living below the poverty level, or no, living above the poverty level. Rural status was determined by the Florida county in which the mother resides. Florida defines a rural county as one with a population of 75,000 or less or a county with a population of 125,000 or less adjacent to a county of 75,000 or less (Florida Department of Health, 2023; Florida Legislature, 2025). Maternal care deserts were defined based on the March of Dimes 2024 Report (Stoneburner et al., 2024). Specific questions regarding the 6-week postpartum visit were extracted from the survey for these analyses, and descriptive statistics for each question were analyzed.

Normality was assessed for the primary outcome questions (Table 2); none met the assumptions for normality. In addition, with the small sample size, especially considering the small number of participants from rural areas, non-parametric tests were chosen, and confounders and effect modifiers were not considered. Independent group tests were used to examine differences between mothers living in rural and non-rural counties: Mann-Whitney U for continuous variables and Fisher's exact test for categorical variables. Missing data were eliminated from analyses; imputation methods were not used due to the small amount of missing data.

Results

A total of 97 participants completed the entire or part of the survey. Five were excluded due to infant age of over one year, and one participant with twins, leaving a sample size of 91. Eighteen of the participants lived in a rural county. Four mothers lived in areas considered to be deserts regarding access to maternity care, and 14 lived with low maternity care access, leaving 80.2% with full access. Demographic data are presented to examine differences based on rurality (Table 1). The only significant differences were in maternal age and eligibility for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); infant birth weight, race, and poverty trended towards significance.

Table 1

Demographic Characteristics of Participants (N = 91)

	Rural	Non-Rural	*p*-value
Maternal Age[1]	27.4	31.1	**0.01**
Baby Age (days)	78.4	84.6	0.79
Birth Weight (kg)[2]	3.53	3.30	0.14
BMI	28.8	28.9	0.99
BSQ (Mean)	21.9	20.9	0.71
Depression Score[3]	8.38	8.34	0.74
Marital Status[4]			0.47
Married	10 (71.4%)	61 (81.3%)	
Single	4 (28.6%)	14 (18.7%)	
Education[5]			0.53
College Grad	10 (58.8%)	50 (70.4%)	
No College	7 (41.1%)	21 (29.6%)	
Race[6]			0.08
White (Caucasian)	12 (70.6%)	51 (73.9%)	
Black (African American)	2 (11.8%)	16 (23.2%)	

	Rural	Non-Rural	*p*-value
Other or Mixed Race	3 (17.6%)	2 (2.9%)	
Hispanic[5]			0.74
Yes	4 (22.2%)	13 (18.1%)	
No	14 (77.8%)	59 (81.9%)	
Work Status (at survey completion)			0.64
Working	12 (66.7%)	53 (72.6%)	
Looking for work	1 (5.6%)	6 (8.3%)	
Unemployed	3 (16.7%)	11 (15.3%)	
Other/Student	2 (11.1%)	3 (4.2%)	
Birth Type[5]			0.56
Vaginal Birth	10 (58.5%)	51 (69.9%)	
C-Section	7 (41.1%)	22 (39.1%)	
Eligible for WIC[4]			**0.04**
Yes	9 (50%)	24 (33.8%)	
No	5 (27.8%)	41 (57.7%)	
Unsure	4 (22.2%)	6 (8.5%)	
Poverty			0.15
Yes	5 (27.8%)	9 (12.9%)	
No	13 (72.2%)	61 (87.1%)	
Baby Friendly Hospital			0.72
Yes	13 (86.7%)	50 (78.1%)	
No	2 (13.3%)	14 (21.9%)	
Attended Postpartum Visit[1]			0.46
Yes	15 (93.8%)	69 (97.2%)	
No	1 (6.2%)	2 (2.8%)	

Note. BMIs under 16 were excluded. [1]n = 87; [2]n = 85; [3]n = 83; [4]n = 89; [5]n = 90; [6]n = 86. Significant values ($p < .05$) in bold.

Seven questions were asked of mothers specific to the postpartum visit (Table 2). Missing data for these questions was minimal, with 4.4% for most of these questions; 19.8% of participants did not answer or had not contacted their healthcare provider, and 12% did not answer the question regarding the benefit of the postpartum visit.

Table 2

Survey Responses of Participants (N = 91)

Variable	Rural*	Non-Rural*	*p*-value	Effect size (*r*)
To what extent were your healthcare providers easy to get in touch with?	3.67	3.52	0.59	0.12
To what extent were your questions sufficiently answered by your healthcare provider?	4.07	4.11	0.79	0.06
What benefits did you have from your postpartum check-up?	3.13	3.05	0.78	0.06
How would you rate your relationship with your healthcare provider?	4.18	3.89	0.27	0.25
To what extent have you received information about the services offered at the health clinic?	**4.24**	**3.5**	**0.02**	**0.52**
To what extent have you received information about your physical health after birth?	**4.24**	**3.43**	**0.01**	**0.58**
To what extent have you received information about possible mood changes since giving birth?	3.71	3.21	0.14	0.33

Note. *Average score on a 1-5 Likert scale. Significant values ($p < .05$) in bold.

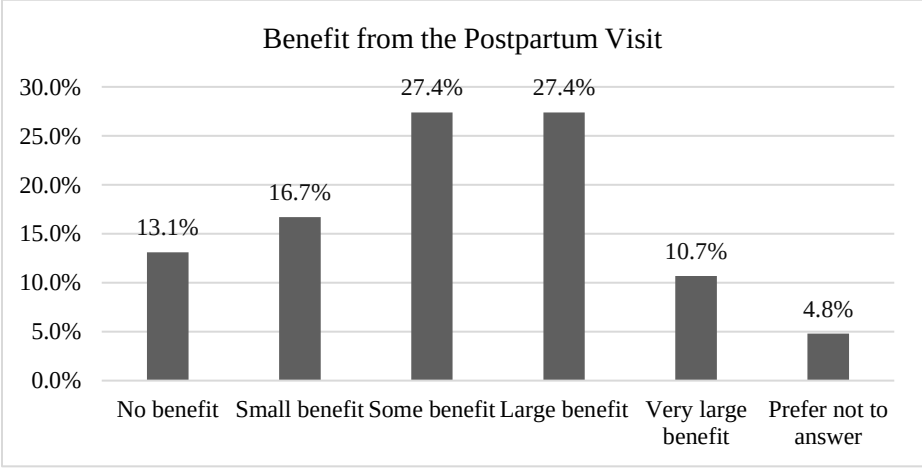
When asked about the benefits of the postpartum visit, only 38.1% of participants found a large or very large benefit to this visit (Figure 1). Although

74% felt their questions were sufficiently answered by healthcare professionals, 50% reported that their healthcare professionals were not easily accessible. About half of the participants reported receiving substantial information on services offered (53.4%), physical health (54.5%), and mood changes (45.5%) after birth (Table 2).

There was a statistically significant, medium difference in perception of information on health services received and information on physical health. Participants from rural areas rated receiving information on health services higher than participants from non-rural areas (M = 4.24 vs. M = 3.5, p = 0.02, r = 0.52). Similarly, participants from rural areas rated receiving more information on their physical health than participants from non-rural areas (M = 4.24 vs. M = 3.43, p = 0.01, r = 0.58). Although it did not reach statistical significance and demonstrates a small effect size, participants from rural areas also rated higher on receiving more information on mental health (M = 3.71 vs. M = 3.21, p = 0.14, r = 0.33) (Table 2).

Figure 1

Participant Perceived Benefit From the 6-week Postpartum Visit



Discussion

This study examined maternal perceptions of the benefit of the postpartum visit, using data from a diverse population in north-central Florida, including both rural and non-rural participants. Consistent with prior literature, most participants did not find large or very large benefit from the 6-week postpartum visit, highlighting the need for restructuring care during the fourth trimester. Most of our participants attended the postpartum visit, with no significant difference between mothers living in rural versus non-rural counties. However, participants from rural counties perceived a greater benefit regarding information received on services offered at the clinic, physical changes postpartum, and mood changes postpartum compared to participants from non-rural counties. This suggests that when mothers from rural counties attend the postpartum visit, they find it beneficial.

These results provide insight into maternal attendance at the 6-week postpartum visit and highlight a potential barrier to attendance—the lack of perceived benefit. According to ACOG, up to 40% of mothers do not attend the postpartum visit (ACOG, 2018). The reasons cited include lack of transportation and financial constraints, such as the need to return to work (Dennis et al., 2007; Henderson et al., 2016). These barriers are heightened for mothers living in rural areas. Mothers often prioritize their baby's needs over their care (Attanasio et al., 2022). ACOG recognizes the need to change the postpartum visit structure, advocating for individualized care plans and smooth transitions to primary care for ongoing management of chronic health conditions (ACOG, 2018). Policy changes may be needed, such as reimbursement for additional visits during the fourth trimester, including the option for telemedicine and home visits for families living in rural areas with limited transportation (Gordon et al., 2025; Society for Maternal-Fetal Medicine, 2023; van den Heuvel et al., 2018). This study contributes to the literature by showing that mothers from rural counties find benefits when they attend the postpartum visit. However, additional information is needed to understand why mothers in this sample had a high attendance rate for the postpartum visit. We suspect that mothers who did not attend the visit did not agree to participate in the research study as the focus was on the postpartum period.

The postpartum visit is of utmost importance as it addresses perinatal complications, chronic health conditions, mental health concerns,

contraception, and referrals to primary care providers for ongoing care. Without this visit, these issues remain unaddressed, thus increasing the risk of postpartum morbidity and mortality. Disparities in attendance are notable, with historically marginalized racial and ethnic groups and rural residents less likely to attend, placing these individuals at higher risk for complications (Admon et al., 2018; Bozkurt et al., 2024; Oribhabor et al., 2020). Systemic barriers such as lack of provider continuity, poor patient-provider communication, low health literacy, insurance lapses, financial concerns, long wait times, and cultural beliefs and practices contribute to lack of attendance (Bellerose et al., 2022; Gordon et al., 2025). Additionally, research suggests lower attendance rates among mothers living in rural areas (Colyer et al., 2020; Natarajan et al., 2023). Although this difference was not seen in our study, differences among rural and non-rural participants were present.

Demographically, rural mothers were younger, more likely to live in poverty, more were eligible for WIC, and their infants were slightly heavier at birth. Despite these differences, rural participants reported receiving more information on available healthcare services, postpartum physical health, and potential mood changes than non-rural participants. However, there was no significant difference in participants' overall perception of the visit's benefit. Though not significant, the generally lower education levels of rural participants in comparison to non-rural participants (58.8% with a college degree vs. 70.4% with a college degree) may explain differences in perceived benefit through baseline level of knowledge related to perinatal health. Additionally, the larger percentage of rural participants living in poverty and eligible for WIC may have amplified a need for additional resources that led to higher perceived benefits in rural populations who attended their postpartum visit. Further research is needed to understand and characterize the influence of this perception on postpartum service utilization and maternal health outcomes.

Aligning with ACOG's (2018) recommendations, our results underscore the importance of addressing postpartum care as a process rather than a single visit. We advocate for individualized care plans focusing on the physical, social, and psychological well-being of new mothers, including mood assessment, infant feeding, sexuality, contraception, fatigue, physical tolls of birthing, and chronic disease management (ACOG, 2018). Future research should explore what mothers find beneficial in postpartum visits to develop targeted interventions to improve attendance (Jones et al., 2019). The

postpartum period is also viewed as a time of rest and recovery, with some cultures emphasizing staying home (Handler et al., 2019; Mokhtari et al., 2018), supporting the need for individualized care and a home care model, which has been successful in various countries and parts of the United States, including federally funded maternal-child home visiting programs (Condon, 2019; Handler et al., 2019; Mokhtari et al., 2018). A recent scoping review provides focus areas for future interventions during the perinatal period for mothers from rural areas (Gordon et al., 2025). Specifically, Gordon et al. (2025) found that interventions should center on increasing care connection and frequency, social support, education, self-efficacy, and positive reinforcement. Our results contribute to this work by identifying the need to discover what mothers value from postpartum visits. These data can be utilized to build comprehensive, resourceful postpartum care.

A strength of this study was its focus on the differences in the perceived benefits of the postpartum visit between mothers from rural and non-rural counties in Florida. Our critical finding of a higher perceived benefit of the postpartum visit in rural participants was unexpected, particularly regarding knowledge about health services and physical health resources. However, this finding provides an excellent avenue for future research priorities, specifically to identify why these mothers attended the postpartum visit. Additionally, there is a need to focus on mothers from rural areas who do not attend the postpartum visit to identify their needs and how to provide care to this population. Limitations include the small number of participants from rural areas, preventing the ability to know whether results are true for all mothers from rural counties.

Additionally, the ability to control for confounding variables was not possible and could influence results. Future research should aim to increase enrollment from rural counties to determine if the differences observed in this small sample hold in a larger sample. While the sample's racial and ethnic diversity closely matches the demographics of the counties studied, its regional focus and overrepresentation of Hispanic participants limits generalizability. An additional limitation was the length of the survey (20-30 minutes), resulting in some incomplete responses, reducing the number of participants and the effect size for later questions.

Conclusion

This study highlights maternal perceptions of the 6-week postpartum visit, focusing on differences among mothers from rural counties compared to non-rural counties. The findings indicate that a substantial proportion of mothers do not find the postpartum visit beneficial and often feel their healthcare professionals are not easily accessible. Mothers in rural areas felt they received more information on healthcare services, physical health, and mood changes than those in non-rural areas. Understanding these perceptions and addressing barriers to attendance are crucial for improving maternal health outcomes.

Our findings emphasize the need to treat postpartum care as an individualized, ongoing process rather than a singular event, which aligns with ACOG recommendations. Individualized care plans that cater to new mothers' physical, social, and psychological well-being are essential. Future research should identify what mothers find beneficial in postpartum visits to develop targeted interventions that enhance attendance and effectiveness. We should also explore the challenges that non-rural and rural populations face individually that may alter outcomes. Additionally, adopting home care models and considering cultural practices can further support postpartum maternal health. This study, with its unique focus on rurality and its influence on maternal healthcare, provides a valuable foundation for future research and policy adjustments to improve postpartum care and reduce maternal morbidity and mortality.

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Postpartum Depression Risk Factors and the Role of Telehealth in Screening and Intervention

Sara Pierpoint, MD, Emma Harrison, Avery Lamb, Kendall Johnson, Amanda Urban, Chantal Scott, MD

Postpartum depression (PPD) is defined as a depressive episode occurring within the first year after delivery. This study aims to identify risk factors associated with higher Edinburgh Postpartum Depression Scale (EPDS) scores and evaluate the impact of a 3-week postpartum telehealth appointment on these scores. A retrospective chart review was conducted on 252 patients who delivered at a single academic center, with 114 deliveries occurring before and 138 after the implementation of the telehealth visit. Of these, 106 patients completed the telehealth visit. Data on patient demographics, pregnancy, maternal health, and delivery were collected. Statistical analyses were performed using ANOVA and student's *t*-test, with a significance threshold of $p < 0.05$. The results showed no significant correlation between EPDS scores and maternal or gestational age at delivery, parity, type of delivery, complications, or NICU admission. However, Black patients had significantly higher EPDS scores compared to other racial groups ($p = 0.038$). Patients with any mental health diagnosis ($p < 0.01$) and those with a history of postpartum depression ($p < 0.01$) also had significantly higher EPDS scores. Implementing the postpartum telehealth visit did not

The authors have no conflicts of interest or funding to report. Sara Pierpoint, MD (ORCID: 0009-0009-8214-2195), is affiliated with the University of Virginia Department of Obstetrics and Gynecology. Emma Harrison, Avery Lamb, and Kendall Johnson are students at the University of Virginia School of Medicine. Amanda Urban and Chantal Scott, MD, are affiliated with the University of Virginia Department of Obstetrics and Gynecology. Address correspondence to sara.constand.pierpoint@gmail.com.

result in a significant decrease in EPDS scores, nor was there a significant difference between patients who completed the visit and those who did not. This study underscores the need for additional or alternative interventions to reduce the risk of postpartum depression effectively.

Keywords: postpartum depression, perinatal depression, maternal mental health, racial mental health disparities, delivery trauma, telehealth implementation

Postpartum depression (PPD) is a major cause of morbidity and disability for women around the world. Historically, PPD has been defined as a major depressive episode that occurs within 1 year of delivery (Carlson et al., 2024). The criteria for a depressive episode are similar to those outside of pregnancy, including distressing symptoms such as depressed mood, loss of interest, sleep or appetite changes, and impaired concentration, which are present during the same two-week period and a significant change from prior functioning (American Psychiatric Association, 2013). Recently, the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) has recognized peripartum depression as any depressive episode that occurs during pregnancy or in the first year postpartum and, therefore, includes postpartum depression (American Psychiatric Association, 2014).

The pathophysiology of PPD results from a combination of many factors, including genetic, environmental, and neuroendocrine changes. Environmental risks include a history of mental health disorders, adverse childhood events, and trauma. Neuroendocrine changes to the hypothalamic-pituitary-adrenal axis after delivery also can cause mood changes (Dennis et al., 2024).

PPD is prevalent, impacting nearly one in seven women during pregnancy or within the year after delivery (Carlson et al., 2025). Globally, it is estimated to affect approximately 17% of the postpartum population (Wang et al., 2021), which notably equates to more cases per year than women with breast cancer or diabetes (Accortt & Wong, 2017). It is important to note that up to 50% of women who experience symptoms of PPD remain undiagnosed. This problem is only continuing to grow. In the last decade, the prevalence of PPD has increased significantly across all racial, ethnic, and socioeconomic subgroups of the population (Khadka et al., 2024).

Given the high and growing prevalence of PPD, it is crucial to understand the potential impacts of this disease. PPD can lead to suicidal thoughts in 5-14% of patients, which is extremely important as suicide accounts for up to 20% of postpartum deaths (Lindahl et al., 2005). Patients with PPD are also at increased risk of causing infanticide (Dennis et al., 2024). Another consequence of PPD includes decreased rates of breastfeeding, which can lead to difficulties in bonding between mother and infant and further worsen PPD severity (Henshaw, 2023) as well as negative health consequences for the infant (Stein et al., 2014). Women who suffer from PPD are also at risk for developing a mood disorder outside of pregnancy, having worse physical recovery from pregnancy, and engaging in substance abuse (Shorey et al., 2018). With the prevalence of PPD so high and its impact so great, more opportunities for screening, identification, and treatment are needed.

Prior research has investigated ways to optimize screening strategies for PPD. Currently, several patient questionnaires are in use, including the Edinburgh Postnatal Depression Screen (EPDS), Patient Health Questionnaire -9 (PHQ-9), Beck Depression Inventory, and Kessler Psychologic Distress Scale (Wells, 2023), although there is conflicting evidence about whether one of these tools is superior. A 2017 systematic review of over 140 studies found no significantly superior method of screening patients (Ukatu et al., 2018). However, a 2022 systematic review concluded that the EPDS was the superior screening tool (Park & Kim, 2023).

In addition to the lack of consensus on the best tool, there is no standardized timing or frequency to screen patients for PPD. Most practices screen patients with depression questionnaires during prenatal visits to help identify patients at increased risk of mood disturbances (Accortt & Wong, 2017). The American College of Obstetricians and Gynecologists (ACOG) recommends screening patients twice prenatally and again at postpartum visits but does not specify the frequency of postpartum screenings (“Screening and Diagnosis of Mental Health Conditions During Pregnancy and Postpartum,” 2023).

The frequency of postpartum appointments varies widely among patients. Attendance at these appointments is also highly variable. A recent National Institutes of Health (NIH) systematic review found that the postpartum visit attendance rate ranged from 25 to 97%, with the average attendance being 72% (Attanasio et al., 2022). However, patients with lower socioeconomic status, lack of insurance, and geographic barriers have decreased attendance rates at

these visits (Ware et al., 2024). This is a growing problem as the maternity healthcare deserts continue to grow in the United States.

In the wake of the COVID-19 pandemic, telehealth utilization increased significantly across all areas of medicine, including postpartum care. Initially from necessity, telehealth was found to be satisfactory for many patients and continues to be utilized in conjunction with in-person visits for many practices (Marshall et al., 2023). Multiple meta-analyses found that telehealth can significantly decrease PPD incidence and severity, although the degree of impact varies with the specific telehealth practices (Liu et al., 2022; Zhao et al., 2021). Nevertheless, a superior method or timing of appointments has yet to be identified. When specifically looking at patient satisfaction, text messaging interventions have been shown to have very high patient satisfaction rates (Lawson et al., 2019).

Overall, there is a lack of recent research looking into the effectiveness of telehealth interventions in decreasing the rate and severity of PPD. This research was founded on the need to address this gap. This study had two objectives: first, to identify which patient or delivery factors correlated with significantly higher EPDS scores at the comprehensive postpartum visit, and second, to assess if implementing a 3-week postpartum telehealth visit for all patients improves EPDS scores at the comprehensive postpartum visit.

Methods

A retrospective chart review identified patients who delivered at a single academic hospital over 6 months. The timeframe was selected so that the implementation of the 3-week telehealth was the midpoint, thus dividing the patients into before and after cohorts. Exclusion criteria included neonatal demise, transfer from outside hospital, or ICU admission around time of delivery. Information regarding patient demographics, maternal health characteristics, delivery information, and Edinburgh Postnatal Depression Score (EPDS) scores was collected. The final EPDS score was recorded at the 6-week comprehensive postpartum visit. Statistical analysis was completed with student's *t*-test and ANOVA as appropriate, with $p < 0.05$ as significant.

Results

A total of 252 patients were identified, with 114 divided before and 138 after implementing the 3-week telehealth appointment. The average age of the

patients was 30.50 years (*SD* = 5.48), which did not correlate with 6-week postpartum EPDS (r = -0.09, p = 0.16). This held for patients at extremes of age, less than 20 years, or 40 years and older (n = 16, r = 0.24, p = 0.37). Among the patients, 102 were nulliparous, and 152 were multiparous. There were 12 documented IVF pregnancies. The racial and ethnic distribution of the patients was 58% White, 17% Black, 13% Hispanic, and 12% Other. Antepartum admissions prior to delivery were documented for 42 patients.

Regarding mental health, 79 patients (31%) had both anxiety and depression reported in their medical history. An additional 32 patients carried a diagnosis of anxiety alone, and another 20 carried only a diagnosis of depression. Another mental health disorder was present on the problem list of 41 patients, including ADHD, bipolar disorder, and substance use disorder. A documented history of postpartum depression was noted in 31 patients.

The average gestational age at delivery was 38.27 weeks (*SD* = 3.07), which was not significantly correlated with 6-week postpartum EPDS (r = 0.001, p = 0.86). Vaginal deliveries were recorded for 170 patients, and 81 had cesarean sections, of which 56 (69%) were unscheduled, and 11 (14%) were emergent cases. Multiple gestation deliveries were documented for three patients, all of whom were scheduled cesarean sections. One vacuum-assisted delivery was documented. Delivery complications were recorded for 40 cases (10 shoulder dystocia, 11 emergency cesarean sections, 18 other, and 1 neonatal code). NICU admissions after delivery were noted for 43 patients' infants. A documented EPDS at their initial visit was recorded for 238 patients (94%), with an average score of 5.65 (*SD* = 4.75). Every patient completed an EPDS at their comprehensive postpartum visit, with an average score of 4.79 (*SD* = 4.95).

The statistical analysis regarding demographics, maternal health, and delivery factors is depicted in Table 1.

Table 1

Comparison of Postpartum EPDS Scores

	Average Postpartum EPDS	Statistics
Nulliparous	5.42 (*SD* 5.25)	*t*-test $p = 0.097$
Multiparous	4.37 (*SD* 4.72)	
Delivery Complication	6.03 (*SD* 4.74)	*t*-test $p = 0.087$
No Complication	4.56 (*SD* 4.97)	
NICU Admission	4.86 (*SD* 5.29)	*t*-test $p = 0.92$
No NICU Admission	4.78 (*SD* 4.90)	
Vaginal	4.65	ANOVA $p = 0.26$
Unscheduled CS	5.54	
Scheduled CS	3.68	
Black	6.36	ANOVA $p = 0.038$
Hispanic	3.13	
White	4.59	
Other/Unknown	5.20	
Anxiety & Depression	6.53	ANOVA $p < 0.01$
Anxiety	6.78	
Depression	5.15	
Other Mental Health Disorder	3.75	
No Mental Health Disorder	3.05	
IVF Pregnancy	3.08 (*SD* 2.91)	*t*-test $p = 0.22$
No IVF	4.88 (*SD* 5.03)	
Any Mental Health Disorder	6.30 (*SD* 5.19)	*t*-test $p < 0.01$
No Mental Health Disorder	3.08 (*SD* 4.05)	

	Average Postpartum EPDS	Statistics
History of Postpartum Depression	7.48 (*SD* 5.60)	*t*-test $p < 0.01$
No History of Postpartum Depression	4.42 (*SD* 4.75)	

Analysis of the impact of the 3-week telehealth visit, which had a 76% completion rate, is depicted in Table 2. No significant difference existed between those who did or did not complete a telehealth visit ($p = 0.42$). Black patients, who had significantly higher EPDSs overall, did not demonstrate a significant difference after the telehealth implementation (6.10 (*SD* = 6.60) vs. 6.91 (*SD* = 5.75), $p = 0.67$). The only subgroup that demonstrated a significant difference in EPDS after the implementation were patients who experienced complications in their delivery (4.29 (*SD* = 3.53) vs. 7.41 (*SD* = 5.26), $p = 0.043$).

Table 2

Comparison of EPDS Scores

	Pre-Telehealth AVG (*SD*)	Post Telehealth AVG (*SD*)	*p*-value
Average for cohort	5.19 (5.01)	4.51 (4.91)	$p = 0.28$
Nulliparous	5.54 (4.88)	5.35 (5.50)	$p = 0.86$
30 and younger	5.60 (5.31)	5.14 (5.60)	$p = 0.64$
>30 years	4.83 (4.75)	3.68 (3.86)	$p = 0.14$
Black	6.10 (6.60)	6.91 (5.75)	$p = 0.67$
Any Mental Health Diagnosis	6.90 (5.08)	5.85 (5.24)	$p = 0.24$
Unscheduled CS	5.00 (5.33)	5.88 (5.11)	$p = 0.54$
Delivery Complication	4.29 (3.53)	7.41 (5.26)	$p = 0.043$
NICU Admission	4.62 (4.77)	5.31 (5.59)	$p = 0.70$
Decrease in EPDS from Discharge to Postpartum Visit	-0.14 (3.72)	-0.48 (4.76)	$p = 0.75$

Discussion

This study was unique because a telehealth visit was implemented for all patients, regardless of their mental health diagnoses. The first arm of this study investigated specific patient and delivery characteristics that increase the risk for PPD. Those traits included Black race, mental health diagnosis, and history of PPD. There was no significant difference regarding parity, gestational age at delivery, IVF pregnancy, type of delivery, delivery complication, or NICU admission. These results mirrored previous literature to varying degrees. Mental health diagnoses and history of PPD have previously been found to be risk factors (Guintivano et al., 2018). On the issue of race, previous literature is mixed, with some studies finding lower rates of PPD in Black populations and others finding higher (Cannon & Nasrallah, 2019; Sidebottom et al., 2023). The finding that NICU parents did not have higher EPDS scores counters previous literature that cited those patients having up to 40% increased rates of PPD (Shovers et al., 2021).

The second arm of this study looked at the implementation of a 3-week telehealth visit. This program did not significantly impact EPDS scores at the comprehensive postpartum visit. Similarly, when looking at specific subpopulations such as nulliparity, Black race, mental health diagnosis, unscheduled cesarean section, or NICU admission, the 3-week visit did not have a significant impact. Interestingly, patients with delivery complications had significantly higher EPDS scores after the telehealth visits started. Perhaps this is due to patients having time to recall and re-experience their trauma. This study's limitation was not documenting what occurred at each telehealth visit, whether interventions were recommended, and if the patient adhered to those. A standardization of telehealth visits could have a different impact on EPDS scores.

Another limitation of this study is that the EPDS was the only screening tool. Other studies investigating postpartum depression often utilize various screening tools. Another notable limitation of this study was that there were no unified diagnostic criteria for any of the mental health disorders listed on the patient's charts. Our reviewers did not investigate who or with what criteria the diagnoses were made but noted that they were listed. Additionally, the severity of the mental health disorder was not noted. A sub-analysis of whether telehealth impacts patients with varying severity of mental health disorders would be an interesting future step.

Additionally, it is important to note that a limitation of this study was that it only addressed postpartum depression and did not address peripartum depression. This could be improved by implementing antepartum telehealth visits for patients with mood disorders that are diagnosed during pregnancy to help address their mental health both during and after pregnancy.

Conclusion

The prevalence of and risks associated with PPD are a significant part of maternal health. Identifying risk factors that may increase a patient's risk of PPD can help providers offer mental health resources during prenatal care. Some of these risk factors include Black race, mental health disorder, and a history of postpartum depression. In the postpartum timeframe, telehealth allows providers to check patients' mental health. The design of the telehealth program is important, as this study demonstrated that a single 3-week visit did not significantly improve EPDS scores.

While the implementation of a single postpartum telehealth visit was a well-intentioned first step, this study demonstrated a need for better interventions to reduce PPD. A protocol was created utilizing a smartphone app that sends patients an electronic EPDS form weekly for 6 weeks until their comprehensive postpartum visit. Upon completion, patients are provided with mental health resources and advised to reach out to their provider if they are concerned about their safety. If patients are prompted to pause to consider their mood more frequently in their immediate postpartum time, this may decrease EPDS scores at the comprehensive postpartum visit. More frequent reflection may encourage patients to seek help from family and friends if they realize their mood is low or to call their provider if they are concerned the symptoms are becoming severe. This protocol was started in mid-September, and enrollment is underway. It will be interesting to see if this protocol helps address and reduce postpartum depression, particularly for the most at-risk patient populations.

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Aspects of Prenatal Aesthetics in Pictures Drawn by Patients with Somatoform Pain

Barbara Ruettner, MD, Adrian M. Siegel, MD, Klaus Evertz, Ludwig Janus, MD, Anett Müller-Alcazar, PhD, Melanie Kappler, Kostja Wacker, Lutz Goetzmann, MD

The visual arts serve as a valuable means for accessing prenatal experiences, including the representation of traumas within the framework of prenatal aesthetics using the model of Laplanche's fundamental anthropological situation and Lacan's paradigm of the real, imaginary, and symbolic aspects of psychological reality. This study examines the drawings of thirteen patients suffering from somatoform pain through the lens of prenatal experiences. They participated in an art therapy group, creating various drawings, with psychoanalytical interviews conducted before and after the drawing sessions. The drawings were analyzed using Visual Grounded Theory, while the interviews underwent Content Analysis. Specifically, details related to the *inner garden* topic were examined under the category *container-position relation* (that reflects the relational position of elements within a container) to reveal insights into prenatal experiences, followed by a co-occurrence analysis to determine additional categories associated with these pictorial details. This analysis identified

The authors have no conflict of interest to disclose. Barbara Ruettner, MD (ORCID: 0000-0003-2814-7760) is a Professor of Psychology at MSH Medical School Hamburg. Adrian M. Siegel, MD (ORCID: 0000-0002-8711-1189) is a Professor of Neurology at University Hospital Zurich. Klaus Evertz is affiliated with the Institute for Art Therapy and Art Analysis. Ludwig Janus, MD is associated with the Institute for Prenatal Psychology and Medicine. Anett Müller-Alcazar, PhD (ORCID: 0000-0002-8919-0589) is a researcher at the Department of Psychology, MSH Medical School Hamburg, and ICAN Institute for Cognitive and Affective Neuroscience, Medical School Hamburg. Melanie Kappler and Kostja Wacker are clinical psychologists, affiliated with the Department of Psychology, MSH Medical School Hamburg. Lutz Goetzmann, MD (ORCID: 0000-0003-3260-897X) is the Director of the Institute of Philosophy, Psychoanalysis, and Cultural Studies, and adjunct Professor at the Clinic for Psychiatry and Psychosomatic Medicine, University of Lübeck. Send correspondence to: barbara.ruettner@medicalschool-hamburg.de.

frequent supplying elements alongside others reflecting corporeality or bodily boundaries. Many of these representations were negative, portraying the container (mother) as a grave or coffin and the contained element (baby) as defenseless and dark in color. Fragmentation observed in the drawings suggests an expression of a fragmented body, with some details coded under trauma-related categories (e.g., position field). The findings indicate a potential link between pictorial references to prenatal traumas and the pain experienced by participants, which may inform approaches in both psychotherapy and art therapy.

Keywords: prenatal aesthetics, basic anthropological situation, trauma, somatoform pain disorder, Visual Grounded Theory

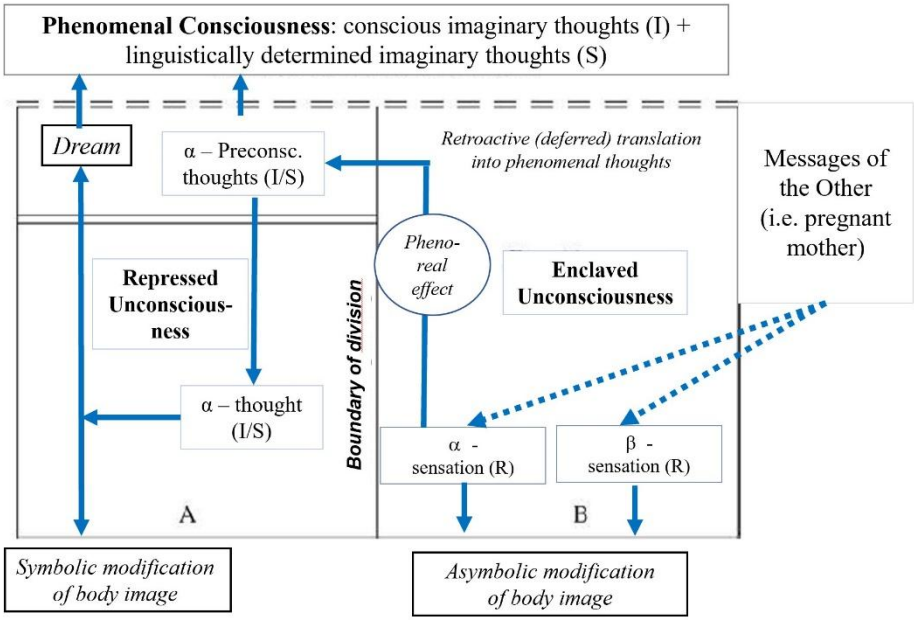
Although prenatal experience is said to have a formative impact on mental life, leaving traces in the affective memory, our memory cannot directly recall pre-birth experiences related to further sensory experiences (Hochauf, 2014). Nevertheless, it is thought that prebirth experiences manifest in retrospective visualizations that can be understood as the offspring of this early reality. Thus, an attempted abortion can be visualized as a seemingly irrational fear of annihilation accompanied by images or narratives of an existential threat (Egloff & Djordjevic, 2020; Evertz et al., 2021; Goetzmann & Janus, 2023; Rank, 2007, 1924). However, when interpreting prenatal aesthetics, it is important to consider that each visualization and image can be understood differently. A further core principle is based on embodiment: body memory and its relation to body image (Dolto, 1984) play an essential role in creating a picture. Equivocality and embodiment are thus important features of prenatal aesthetics. In this context, aesthetic forms can also represent prenatal traumatization (Evertz, 1997). Fragmentations and signs of physical and mental deprivation are often to be found.

Viewing prenatal psychology from a psychoanalytical perspective, the fundamental anthropological situation, as described by Laplanche (2011), has existed in principle since the pre-birth period. According to Laplanche, enigmatic messages that originate from an adult's unconscious encounter the child's unconscious. These messages are implanted in the so-called enclaved unconsciousness. However, even during pregnancy, the unborn child would

absorb certain maternal messenger substances via the maternal blood (*inter alia* endocrine substances such as cortisol, oxytocin, or some interleukins that regulate immunological reactions). The blood is transported in the umbilical cord. Therefore, the first messages of the *Other*, i.e., of the mother, are conveyed via the umbilical cord. Moreover, the baby also hears and feels the mother's heartbeat, hears her voice, and receives further environmental signals. Babies feel the contact when their parents touch the mother's belly, but they also feel the physical closeness of their sibling in a twin pregnancy. These are all prenatally received messages of the Other that are mysterious, which carve themselves into the baby's real unconscious (cf. Goetzmann & Janus, 2023). Figure 1 shows this process related to Laplanche's theory as a model of psychological functioning in the prenatal period.

Figure 1

Model of Psychological Functioning in the Prenatal Phase



These sensations (in the enclaved unconscious) occur in two different forms: firstly, as sensations that are transformable or translatable (α-sensations), and secondly, as non-transformable sensations (ß-sensations) (*see*

Bion, 1962). Since the latter exceed the translation capacity of the subject, they must, for example, be discharged by the body (which leads to an asymbolic modification of the body image). However, α-sensations can be translated from the real, as Lacan says (2021), directly into the imaginary register. Lacan distinguishes between the real, i.e., the unrepresented unconscious, and the imaginary, which consists of images but also, as we might add, of sounds, smells, tastes, the sense of touch, and feelings. The third dimension is the symbolic, which expresses itself in language and its associated structures (e.g., the law). These three things are connected in the so-called Borromean Knot and form the psychic reality. Imaginary thoughts are initially preverbal and, in this sense, phenomenal. Accordingly, preverbal consciousness can also be described as phenomenal. An early translation during the pregnancy enables the baby to develop, therefore, a phenomenal consciousness.

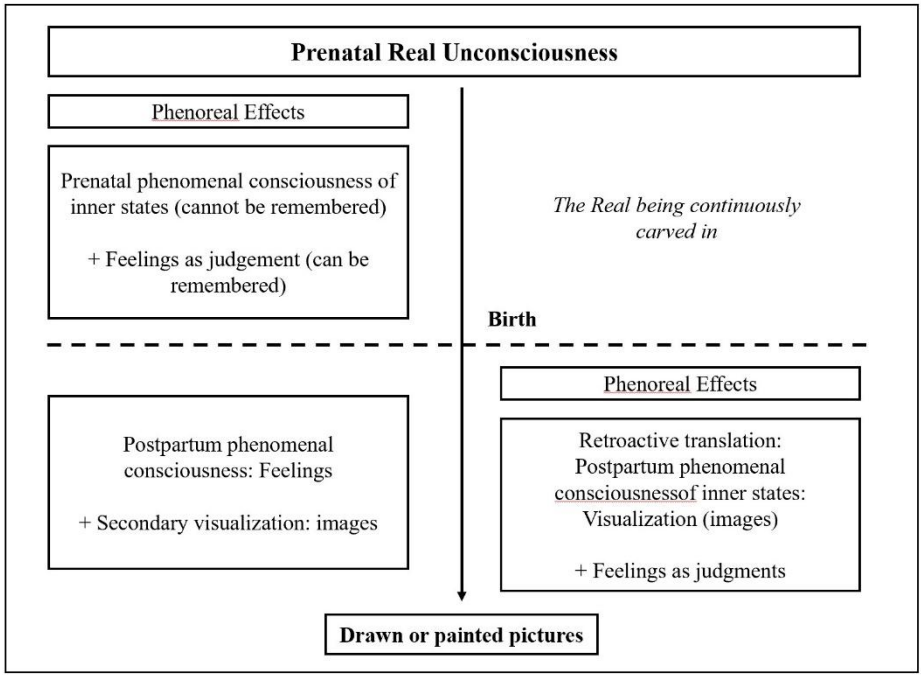
We call this early translation from the real to the phenomenal-imaginary the *phenoreal effect*. It is the transformative effect of the messages in the enclaved unconsciousness on imaginary thinking (Goetzmann et al., 2024a). These phenomenal inner states of the baby, we assume, are evaluated by various feelings (Goetzmann et al., 2024b). Unlike the sensory sensations, which cannot be remembered, these feelings can be recalled and subsequently illustrated as if in dream life. In this respect, feelings shape the first form of a phenomenal consciousness that can be remembered, while further imaginary thoughts are definitively forgotten. Recent investigations have shown that emotion-like behaviors and roots of emotions occur as early as during fetal life (Delafield-Butt & Trevarthen, 2013).

On the subject of fetal development, it can furthermore be said that the fetus is processing sensory stimuli, including painful stimuli, at a cortical level from around the 25th week of pregnancy and that in the 34th week of pregnancy, the fetus is not only capable of perceiving complex sounds outside the womb but can also distinguish between different sounds (Kadic & Kurjac, 2017). These experiences can be translated retrospectively, i.e., across the entire lifespan postpartum, into imaginary thoughts (in the sense of thing-presentations). Moreover, they can be determined linguistically (in the sense of word-presentations). These effects of the Phenoreal are processed through selection, displacement, condensation, projection, and, if necessary, renewed repression in the machinery of the knowledge register. The repressed imaginary and symbolic contents may return in dreams or body symptoms.

During the pregnancy or afterward, the prenatal *real*, i.e., the unconsciousness that is not represented, exerts a phenoreal effect on the imaginary register of knowledge (Goetzmann et al., 2024a) in the sense of *afterwardsness*. Afterwardsness means that certain contents of the real are translated only into the imaginary-symbolic registers later in the course of further cognitive development (Laplanche, 1992). Figure 2 shows the two translation trajectories during and after the prenatal period:

Figure 2

Translation Pathways of the Prenatal Unconscious



This model of the psychological development of the fetus, shown in Figure 2, forms the theoretical framework of our study. We suggest that there is a prenatal real unconsciousness that is already translated prenatally into a phenomenal consciousness. This prenatal consciousness is evaluated by the corresponding prenatal feelings, which can actually be recollected, unlike the further imaginary contents of prenatal consciousness. Moreover, we assume that even in childhood or adulthood, the prenatal real can be translated

afterwards into the phenomenal-imaginary. Thus, the painted pictures, which have the structure of a container, could be understood as retroactive or deferred translations of the prenatal unconscious, whose formation is co-determined by the recollected feelings from the prenatal period. With this in mind, we propose to outline below the results of an analysis of pictures drawn by patients diagnosed with somatoform pain disorder. The international classifications ICD and DSM have different concepts regarding the so-called somatoform pain. In ICD-10, somatoform pain disorder (ICD-10: F45.40, World Health Organization, 2024) is described as a syndrome whose symptoms consist of the subjective experience of pain that cannot be adequately explained by physical impairment.

In the DSM-5-TR conception of somatic symptom disorder, no significant importance is assigned to the influence of the mental state on the physical symptom of pain (American Psychiatric Association (APA), 2022). It is rather a question primarily of the physical effect of the pain on the mental state. In this respect, the DSM-5-TR concept is more or less unidirectional, i.e., physical pain has psychosocial consequences (APA, 2022). On the contrary, however, the upcoming ICD-11 version of the bodily distress disorder assumes a mutual interaction between body and mind: somatoform pain symptoms are both triggered and sustained by emotional distress (*see* Fink & Schröder, 2019; Gureye & Reed, 2016). This article will follow the phenomenological ICD-10 description of somatoform pains.

Our study aims to empirically investigate the prenatal worlds of patients suffering from somatoform pains via their artwork. We are interested in exploring prenatal worlds in direct contact with the pictures. We decided to study all of the details in the pictures on the theme of the *Inner Garden* coded with the category of a container-position-relation that reflects the relational position of elements within a container. We assumed this code identifies pictorial motifs reflecting the baby's position in the mother's body. Accordingly, the following questions arose: (1) Are there pictorial motifs coded with the category container-position-relation? What additional codes occurring together with these motifs were assigned? (2) Can references to prenatal aesthetics be identified? (3) Are there references to forms of prenatal experience that could be linked with the origin of the pain?

Methods

The sample consisted of 13 patients treated in the Clinic for Psychosomatic Medicine and Psychotherapy of the Segeberg Clinics in Bad Segeberg. The ages of the patients, eleven women and two men, ranged between 41 and 62 years *(M* = 49; *SD* = 8.29*)*. Since this was a qualitative study with a considerable amount of data (two interviews, three images per participant) that did not require sophisticated statistical analysis, we considered the sample size of 13 participants to be appropriate from a scientific perspective. The unequal distribution of genders reflected the distribution in the entire patient population of the psychosomatic clinic about the diagnosis of a somatoform pain disorder.

The inclusion criteria were being between 18 and 65, fluent in German (to be able to participate in a psychodynamic interview), and having a clinical diagnosis of persistent somatoform pain disorder (ICD-10: F45.4). Exclusion criteria were dementia, a psychotic disorder, and the presence of physical disorders as the source of the pain. These exclusion criteria prevented patients with cognitive difficulties from participating in a linguistically differentiated interview (regarding dementia). They also excluded patients suffering from body hallucinations and body-related delusions as well as from pain that could be caused by physical illness (regarding psychosis or physical illness). Patients were informed about the study verbally and in writing and consented to participate in writing. Patient data were pseudonymized. The Ethics Committee of the University of Lübeck approved the study. The study design consisted of participation in two interviews conducted by psychoanalytically trained therapists.

In the period between the interviews, the patients were asked to draw three pictures on the themes Inner Garden, Mirror Cabinet, and Floodgate of Feelings. The pictures were drawn on a sheet of A4 paper with a choice of pastels, watercolors, water markers, ink, colored pencils, wax crayons, pencils, and charcoal crayons. The interviews were audio-recorded, transcribed according to the usual rules (Kruse, 2014, p. 349–368), and imported into the ATLAS.ti software. Photographs of the pictures were also imported into ATLAS.ti. The total qualitative dataset consisted of 26 interviews and 39 pictures. To limit the focus on the qualitative data, we restricted ourselves to analyzing 13 images on the theme of the Inner Garden.

For the pictorial analysis, we used Visual Grounded Theory methodology (Goetzmann et al., 2018), which is based on Ulrich Moser's analysis of dreams

(Moser & Hortig, 2014; Moser & Hortig, 2019; Moser & von Zeppelin, 1996). Grounded theory is a qualitative research method developed by Glaser and Strauss (1967). It involves qualitatively investigating a specific research topic, for example, by coding texts and developing hypotheses about the research topic. Visual grounded theory combines the research methodology of grounded theory with Ulrich Moser's structural dream analysis, which focuses on dream images conveyed through language (Moser & Hortig, 2019). In this structural image analysis, cognitive elements, their attributes, and the relations between the elements are coded in the appropriate position, movement, and interaction fields (the codebook in Table 1).

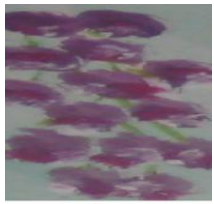
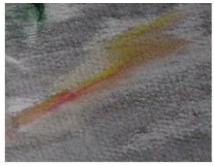
In the visual analysis, we applied exclusively structural codes, which were theoretically defined (using Moser's coding system). Thus, this approach was only deductive. Specifically, a section of the image corresponding to the definition of a particular code was selected, and this selected section was assigned to this code. Although we proceeded deductively in this data analysis, inductive coding (in which the codes would have been developed immediately from the visual material) would have also been an alternative possibility. We chose the deductive approach to capture the psychodynamic structure of the images (analogous to Moser's dream image analysis).

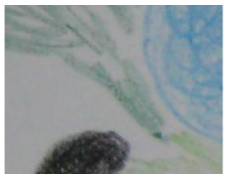
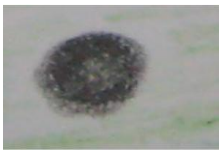
We used deductive and inductive codes when analyzing the interviews; however, this analysis is not considered in this article. In the presented analysis, all picture details coded with the position relation in a container (CONT POS REL) were studied to record possible aspects of prenatal experience or aesthetics. We assumed that such a category is most likely to depict the situation of a baby in the mother's womb from the perspective of the adult drawing the picture. Based on this assumption, we conducted a co-occurrence analysis to examine the joint occurrence of further codes or categories *inter alia* to determine whether categories pointing to a so-called *deaffectualization* (per Moser & Hortig, 2019) in terms of a traumatic reaction or the processing of trauma occur. Thus, we assessed whether the code CONT POS REL and a further code are used in the same section of the picture. Table 1 presents the codebook, including the interrater-reliability known as Cohen's kappa. It is defined as the degree of agreement between the codes assigned by the two raters for a particular section of the image (Landis & Koch, 1977).

Table 1

Codebook with Interrater Reliability of the Pictures Inner Garden

Name	Code	Definition	Example of an anchor	Interrater reliability
Field		The sections of the image are defined as a field and correspond to an abstract cognitive construction.		
Position field	POS FIELD	The cognitive elements are static and immobile; there is no interaction between them.		.92
Field of movement	LTM FIELD	Movements of the individual cognitive elements take place.		.81
Interaction field	INTERACT FIELD	Interactions between at least two cognitive elements.		.93
Cognitive element	CE	All objects, figures, and abstract drawings, that are present in a picture.		

Name	Code	Definition	Example of an anchor	Interrater reliability
Living cognitive element	CEA	Cognitive elements that are alive and self-propelling.		1.00
Inanimate cognitive element	CEI	Cognitive elements of the physical world.		
Figurative inanimate cognitive element	FIG CEI	Concrete elements or abstract drawings with clearly recognizable boundaries.		.83
Substance-like inanimate cognitive element	SUBST CEI	Cognitive elements have a substance-like, less clearly defined, amorphous quality.		.85
Cognitive element, part	CE PART	Parts of animate or inanimate cognitive elements.		.79
Attributes		Attributes describe the characteristics of the cognitive elements.		

Name	Code	Definition	Example of an anchor	Interrater reliability
Boundary attribute	BOUND ATTR	Describes the boundaries, the surface, or the outside of a cognitive element.		.87
Functional attribute	FUNC ATTR	Describes the practical function of a cognitive element.		.94
Global physical attribute	GLOB BOD ATTR	Characterizes the general physical state of a cognitive element.		.91
Relationship	REL	Relationship between two or more cognitive elements.		
Positional relationship	POS REL	Static relationship between two or more cognitive elements without interaction.		.80
Distance-position relation	DIST POS REL	Spatial distance between the cognitive elements.		.93

Name	Code	Definition of	Example of an anchor	Interrater reliability
Container-position relationship	CONT POS REL	Represents the relationship between a cognitive element with another cognitive element that serves as the container of the first element.		.86
Auxiliary position Relationship	AUX POS REL	Relationship that shows how one cognitive element uses or needs another as support or is supported by it.		.80
Defensive deanimation transformation	DEF DEAN TRANS	Animate cognitive element is represented as lifeless, inanimate. The result is the absence of animation or life.		.80
Defensive dehumanizing transformation	DEF DEHUM TRANS	The animate cognitive element is dehumanized by the representation in a non-human form.		1.0
Embedding the transformation	TRANS EMBEDDING	An animate cognitive element is embedded in a place.		.08

Results

Overview of the Quantitative Results

First, we checked whether and how often the code CONT POS REL was assigned to all 13 pictures with the theme Inner Garden. All in all, we found 195 picture details coded with this category. The next step was to carry out a co-occurrence analysis. Table 2 overviews the number of coded picture details that appeared together with the code CONT POS REL.

Table 2

Results of the Analysis of Co-Occurrence to the CONT POS REL Category in the Pictures Inner Garden

Cognitive Element		**Field**		**Relationship**	
FIG CEI (figurative, inanimate element)	80	POS FIELD (position field)	161	POS REL (Position relationship)	74
CE PART (animated element, part)	70	LTM FIELD (loco time motion)	49	DIST POS REL (distance-position relation)	71
SUBST CEI (Substance-like inanimate cognitive element)	58	INTERACT FIELD (interaction field)	14	AUX POS REL (auxiliary position relationship)	48
Attribute		**Defensive Transformation**			
FUNC ATTR (function attribute)	176	DEF DEAN TRANS (Defensive Deanimation)	18		
GLOB BOD ATTR (global body attribute)	155	DEF DEHUM TRANS (defensive dehumanization)	7		
BOUND ATTR (attribute boundary)	151	DEF EMBED TRANS (Defensive embedding)	6		

As Table 2 shows, *attribute* categories occur most frequently with the code CONT POS REL: attributes indicating a function, describing a general bodily state, and marking a boundary. The *position field* categories (referring to a trauma defense) of the figurative inanimate element occur similarly frequently. The codes referring to parts of an animate element or a substance-like consistency occur less often. Progressive transformations do not occur, but defensive transformations indicating a warding-off of traumatic experiences do occur. The results could be interpreted against the backdrop of prenatal aesthetics as the predominant structural elements are attributes showing the maternal care function, the child's body, and its boundaries. We shall now discuss a selection of these and other picture details.

Co-Occurrence Field, Container-Position Relation

POS FIELD (Position Field)

The following pictures contain position fields in which the element does not move. Position fields associated with the category CONT POS REL occur in the pictures Inner Garden of all thirteen patients. Patient L, for example, painted the following picture, which we coded with the open-ended category *person in the river.*

Figure 3

Person in the River (POS FIELD)

The background of the picture detail, painted by patient L, consists of a marbled light-blue fabric-like substance streaked with dark-blue lines. The boundaries of the lines are fuzzy and bleed into the background color. A rudimentary black figure can be seen in the center of this field. The figure consists of a head and torso with arms and legs. Hands, feet, and face are missing. The boundaries separating the figure from the bluish background are fuzzy. In the lower right-hand section of the torso is a blurred white ring-shaped structure radiating shoots into the figure's black. This structure could represent a small heart on the wrong side of the body. The little figure comes across as completely defenseless.

A further picture detail is a grave with flowers painted by Patient B:

Figure 4

Grave with Flowers (POS FIELD)

A greenish-tinged immaterial substance contains an oval shape featuring a wreath-shaped structure with circles and connecting lines. In this shape's center is a flower with a yellow blossom. At the edge are two further flowers. The oval structure depicts a position field containing the yellow flower; it evokes a grave, with the flower as its contents. This little flower also appears alone and helpless; it seems dead, although it has a yellow blossom. Possibly, the picture shows the mother's depressiveness. We could also be dealing here with a prenatal

maternal introject, e.g., an unmourned death in the mother's biography. Further position fields serving as containers for content are, e.g., a dead-looking figure on a meadow, a wicket gate with a face, the sun in the sky, a head with tears, and a blood-filled pond. We have the impression that here, in a position field indicating a traumatic experience, the baby in the womb is being represented.

LTM FIELD (Loco Time Motion, Movement Field)

Movement fields with the container motif occur in all patients' drawings. Patient M, for example, painted the following picture.

Figure 5

Small Boat Sailing on the Sea (Movement Field)

Semicircular blue wave-shaped structures fill a movement field in which, at its center, a small boat with a yellow sail and a small stick figure is sailing. The atmosphere fluctuates between a feeling of safety in the boat and great loneliness. Similar subjects depict lightning and raindrops in the sky, tears running over a face, traces of blood, or tanks in motion.

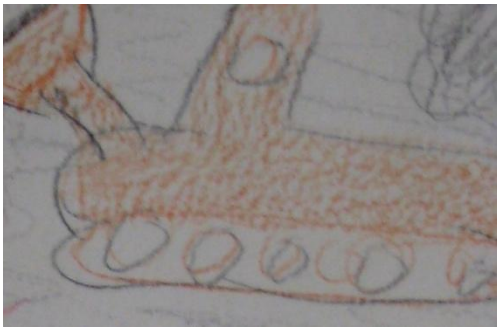
Co-Occurrence Cognitive Elements, Container-Position Relation

FIG CEI (Figurative Inanimate Element)

All patients drew or painted pictures featuring inanimate figurative elements in a container. Patient E, for example, drew a tank.

Figure 6

Tank (FIG CEI)



At the bottom of the tank there are several red and black wheels. They are next to one another and touch. The reddish color of the tank evokes the inside of the womb, but the atmosphere appears to be life-threatening. The tank represents war and destruction, or protection from destruction. Similar motifs are a lightning bolt, a house, a boat, a barbecue, a bench, or eyes, e.g., with the word “salt” (possibly as a defensive substitute for tears).

CE PART (Animate Element, Part)

Twelve out of 13 patients drew or painted pictures with animate elements, which are only shown as parts. Patient F, for example, painted a bush with berries.

Figure 7

Berry Bush (CE PART)

In a green position field, raspberry-red, ragged blotches are depicted. The boundaries of the blotches are blurred. Could this represent an abortion, with streaks of blood and scraps of tissue? Or a fragmentation? Similar motifs are trees with fruit and roses and hedges, generally with flowers or birds.

Co-Occurrence Attribute, Container-Position Relation

FUNC ATTR (Functional Attribute)

All patients drew or painted elements with functional attributes. One example is Figure 4. The grave contains a flower. It is the grave's function to hold the flower in its interior. Perhaps the grave represents a depressive mother who is pregnant with the flower. In another picture, a watering can contains water, or a coffin is directly shown as a container.

GLOB BOD ATTR (Global Bodily Attribute)

All patients drew or painted pictures whose elements have global bodily attributes. Such an attribute would be the wounding of a plant affecting its entire figure. This picture was painted by Patient F:

Figure 8

Wounded Plant (GLOB BOD ATTR)

A serpentine plant-like structure is in front of a greenish-marbled position field shading into light green on the left. The white flecks that the leaves contain look like injuries or scars in the flesh. The plant as a whole has something fleshy yet injured about it. Comparable picture elements are a penis, a pyre, a mutated plant, or a dead figure (lying in a meadow).

BOUND ATTR (Boundary Attribute)

Twelve out of 13 patients drew or painted pictures containing elements with clear boundary outlines. Patient F, for example, drew a figure evoking a penis with clear boundary outlines: the sperm is dammed up at the tip and is prevented from flowing out by a grating.

Figure 9

Penis (BOUND ATTR)

AUX POS REL (Auxiliary Position Relation)

Eight patients drew or painted pictures in which auxiliary position relations occurred, always associated with the container motif. Patient G, for example, drew the following picture in Figure 9.

Figure 9

Eyes (AUX POS REL)

We see two almond-shaped eyes with blue irises positioned in a face. Leaking from the left eye (from the viewer's perspective)—probably instead of tears, which are defensively transformed into language—is the word *Pein* (torment); from the right eye, the word *Angst* (fear). The eyes enable these words (tears) to be shed. In this picture detail, although the mother can support and bear the baby, the baby experiences fear and torment. Comparable motifs are a bush with berries, a grave with a flower, birds in trees, or sun in the sky.

Discussion

In this paper, we studied the pictures drawn by pain patients treated in a psychosomatic clinic setting. We analyzed the pictures using the Visual Grounded Theory method (Goetzmann et al., 2018) based on Ulrich Moser's structural dream analysis (inter alia Moser & von Zeppelin, 1996 and Moser & Hortig, 2019). At the bottom, all interpretations of artistic works that consider prenatal aesthetics are based on the methodology of conjectural reason (Vassalli, 2001), i.e., on Freud's process of surmising and deciphering. With this in mind, we decided to study all picture details coded with the container-position relation. This category reflects the relationship between an element and a container, i.e., between the baby and the mother's body in which the baby is positioned. We are dealing here with a retrospective revision of the situation, as the unborn child itself does not know that it is the body of another human being. Rather, the adult would use this knowledge to represent prenatal experiences pictorially. However, the child likely possesses a phenomenal consciousness related to imaginary experiences (especially sounds, taste, and touch). These experiences can be judged by effects that can be remembered. Alternatively, real sensations are translated retrospectively, e.g., when drawing a picture. Thus, we assume that the container situation represents the framework within which the earliest experiences – in the form of effects or retrospective transmissions – can be pictorially represented. We suspect it is no longer possible to decide which trajectory predominated in the case of the individual picture motif. Of course, it is possible, and even likely, that the prenatal pictorial motifs are revised according to subsequent postpartum experiences, i.e., that these later experiences influence the pictorial representation. With this in mind, let us now discuss our results.

All patients drew pictures where container-position relations or container motifs occur. All patients employed *position fields* in which the elements do

not move. The said elements often come across as dead or defenseless, as in the example of the person in a river (Figure 3), whose heart is on the wrong side of his body, or a flower lying in a grave (Figure 4), possibly depicting a baby floating as if dead in the amniotic fluid or buried in the mother. This illustrates the child's position within the mother's body while also suggesting a form of trauma related to an attempt to evade the realization of a complex, specifically a traumatic interaction. However, no interaction occurs in *movement fields* (employed by twelve patients). These pictures leave the impression that, with the help of prenatal aesthetics, the painting or drawing ego is portraying situations of forlornness and loneliness, when a solitary person sailing on the sea (Figure 5) or tears running down a face (Figure 10). More rarely, the *interaction field* is employed (five patients).

Figurative inanimate elements (e.g., tanks) occur relatively frequently. The reddish hue of the tank evokes the inside of the womb (Figure 6). Here, too, however, the mood seems to be hostile to life. Similar motifs are eyes with the word "salt" (Figure 10), most likely referring to tears. In this case, the pictures would represent an early subjectification of the unborn child in the form of inanimate elements. All patients drew or painted pictures with animate elements shown as parts or individual parts. Thus, a patient painted a bush with berries (Figure 8). Lacan (2006, p. 78) described the phenomenon of the fragmented body, which he characterized as a regression to the time before the mirror stage. Such a fragmentation possibly refers to the earliest experiences in the mother's body, perhaps even to the experience of an attempted abortion or to the stress states of the mother, which attacked the child's phenomenal bodily experience.

Twelve patients drew or painted pictures with inanimate substance-like elements. The sea in Figure 5 might stand for the amniotic fluid, the little boat for the embryo. It is cold, rough, and lonely. As might be expected, attribute categories occur most frequently, specifically attributes referring to a function. In the relationship to its content (baby), the container (mother) has a function. The function of the mother is to ensure that the baby has a protective and nurturing environment. The elements in the container function (the mother or baby) have general bodily attributes and attributes marking a boundary. In this case, the earliest experience of the enveloping skin would be represented in the pictures. Referring to Esther Bick, Brenner (2022) speaks of a skin container that is initially introjected and later serves as a psychic container. The pictures

with clear boundaries and outlines would be like snapshots of this introjection process.

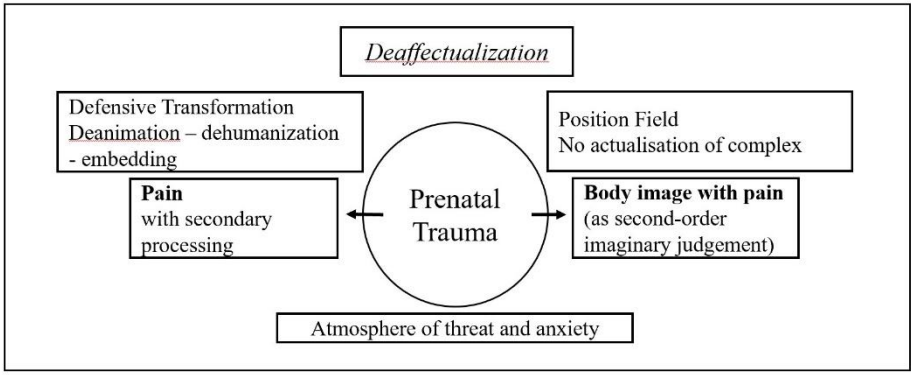
Eight patients drew pictures in which auxiliary position relations occurred. The container (e.g., the eyes in Figure 10) is in a helpful relationship with the Contained, for example, with the tears, which have been defensively transformed into words. The eyes, i.e., the mother, help the tears to flow and the child to be born. These results must also be understood against the findings that emotion-like behaviors and roots of emotions occur as early as fetal life (Delafield-Butt & Trevarthen, 2013).

Together with the category of the position field, motifs coded with the categories of a defensive transformation (*deanimation*, absence of animation or life; *dehumanization*, absence of human characteristics; and *embedding*, absence of individual characteristics) refer to a *deaffectualization*, a regulation of traumatic effects (Ruettner et al., 2021). It seems to be the case, therefore, that traces of the earliest traumatic experiences can be identified in prenatal aesthetics. Twelve patients drew or painted pictures with threatening motifs, with one drawing a lightning bolt. Comparable motifs are a carnivorous plant, the wicket gate with a face, tanks, storms, or a pool with blood.

Establishing a plausible connection between forms of prenatal experience and the origin of pain is undoubtedly a challenge. Knowing that many pain patients experienced postpartum traumatization in their childhood, one might posit that the traces of prenatal traumatization could also be associated with the subsequent development of chronic pain. In this case, the pictures created would be imaginary transpositions of a body image with traumatic injuries. Bodily states are judged by the effect of pain. In the interviews, all patients reported childhood traumatizations (Ruettner et al., 2021), and the pictures feature a variety of codes pointing not only to a deaffectualization (in the sense of minimizing the intensity of the effect) caused by trauma but also to fragmentation and injuries. Some motifs appear threatening, while others project an atmosphere of anxiety. Most human pain is possibly due to the primal pain of not being truly welcome (cf. Ferenczi, 1929; Janus, 1996). As Figure 11 shows, a connection between traces of prenatal trauma and the subsequent experience of pain might be established as a phenoreal effect that results in the translation of real sensations into imaginary states. This translation constitutes the body image, which may be judged by the effect of pain. It is also possible, however, that the pain is directly remembered and secondarily imaginarily illustrated.

Figure 11

Prenatal Trauma and Pain



Limits of the Study

The limits of this study are diverse. Its qualitative orientation is not suited to making generalizations; instead, qualitative research frequently serves to generate hypotheses. We studied thirteen patients only; the sex ratio was markedly imbalanced (eleven women, two men). Another limiting factor is restricting the pictorial analysis to 13 of 39 pictures with the theme Inner Garden. Above all, though, there are at most indications of traces of a prenatal experience that might also stem from later phases of life or be revised by experiences from later phases of life. It might also be possible that prenatal experiences are represented outside the context of a container-position relation in the pictures. However, it struck us as sensible to study only those picture motifs referring to the situation of pregnancy in the first approach.

It must be borne in mind that in art therapy, we generally work with the sensations and feelings of the patients, which they express in the drawing or painting process and the reception of their pictures. Our structural-empirical study represents a unidirectional analysis of the qualitative pictorial material. Here, it is a matter of a joint and relational approach to the potential messages of the picture. This represents the hermeneutics of prenatal aesthetics that can be understood more comprehensively through relational imagery interpretation. Even if a difference persists between an empirical-scientific study and the common art-therapy interpretation, we shall also, in the next step, consult the information from the interviews to expand on the interpretation of the pictures.

In this article, however, it was important for us to approach questions of prenatal aesthetics with the help of a structural picture analysis. Future studies should also include more men and non-binary individuals and not just focus on patients with somatoform pain. Perhaps artificial intelligence methods could also be utilized to standardize image sections concerning structural codes.

Conclusion

Our study has shown, we hope, that pictures drawn by patients can indicate a prenatal experience. This is interesting in many respects. Firstly, the question gives rise to how and by what means prenatal experience can be represented imaginarily and what role the effects play in this translation process. We are convinced that Lacan's RSI-paradigm (i.e., the real, imaginary, and symbolic that are connected in the Borromean knot) and Laplanche's model of a fundamental anthropological situation can be applied to prenatal circumstances (Lacan, 2021; Laplanche, 2011). One might say that early phenoreal experiences are transformed into the adult's imaginary-symbolic registers. It would then be possible to link these contents (e.g., as the presentation of death, defenselessness, injury, or fragmentation) back to the prenatal experience that is real and could be seen in the intersubjective field of the Other's messages.

A prospective study in which the mothers are interviewed during pregnancy (or even in which their stress state is measured physiologically) and in which subsequent pictures drawn by the children or adolescents and their statements in interviews are qualitatively investigated would most likely bring further insights and scientific clarity here. Above all, however, drawing pictures within a psychotherapeutic or art therapy setting offers a way to address prenatal topics and experiences potentially of existential importance to patients. Thus, our findings have immediate clinical implications. It is possible that patients with somatoform pain can express themselves by painting pictures of deep, even prenatal experiences in an initially preverbal way. In this way, early, potentially traumatic experiences, which are also responsible for the development of pain, can be emotionally processed. The pictures can also be discussed in psychotherapy or psychoanalysis, thus enabling verbalization and, above all, opening up a space for understanding emotional and mental processing for patients.

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The Subcellular Psychobiology Theory: Connecting Epigenetic Biology to Trauma

Kirsten Lykkegaard, DVM, PhD, Mary Pellicer, MD, Grant McFetridge, PhD

One of the biggest unknowns in epigenetic research is how to target specific genes to restore their inhibited expression. In this paper, we give a solution to this problem by describing how to target and repair an epigenetically inhibited gene using simple psychological trauma-healing techniques (e.g., Eye Movement Desensitization and Reprocessing (EMDR)). Importantly, we also show how to find the causes of psychological disorders, other diseases of unknown etiology, and the relevant inhibited genes of these disorders and diseases. Together, this means that a psychotherapist, using simple trauma-healing techniques, can target and quickly eliminate a specific psychological disorder in their clients. Most importantly, we can now treat disorders that were not treatable before.

In this paper, part two of a three-part series, we derive the subcellular psychobiology theory by examining the biology of the primary cell (Lykkegaard et al., 2024). Using prenatal regression to observe the cell interior, we find that *traumatic* memories are accessed in ribosomes inside the primary cell. In turn, we show how epigenetically damaged gene coatings are the source of the traumatic feelings found in these memories. Effective trauma-healing techniques take advantage of this intracellular biology. We also discuss some

The Institute for the Study of Peak States was founded in Canada in 1998 by Grant McFetridge, PhD (ORCID: 0000-0002-8917-6613). This privately funded international research, training, and clinical institute focuses on understanding the psychobiology behind exceptional mental and physical wellness. Many talented volunteers did this work without funding as part of the research efforts of the Institute. Kirsten Lykkegaard, DVM, PhD (ORCID: 0000-0001-7602-1578) directs the fundamental research team, and Mary Pellicer, MD (ORCID: 0000-0002-5335-7957) directs the psychoimmunology applications team. We have published five textbooks so far; in particular, the *Subcellular Psychobiology Diagnosis Handbook* (2014) for trauma therapists covers diagnosis and treatment for several intracellular diseases. This paper is dedicated to our inspiring research colleague and close friend, Adam Waisel MD (Israel), who died of a heart attack in 2006. Please address all correspondence to kirsten@peakstates.com and learn more at PeakStates.com.

safety issues with research using psychobiology techniques that interact with or change the primary cell's intracellular biology.

Part three of this paper (published in *JOPPPAH* 39.2) gives three examples of practical applications of the subcellular psychobiology theory: dizziness, hearing voices, and Asperger's Syndrome.

The Primary Cell Model Explains Edge Cases in Trauma Therapy

In part one, we described the primary cell model (Lykkegaard et al., 2024). Experientially, the primary cell is where our consciousness resides, and our everyday experience is a mixture of sensations, feelings, and perceptions from the body mixed with those from inside the primary cell. This was an unsuspected link we discovered between intracellular biology and psychology. But did it really exist? Our first evidence came from trauma therapy.

By 1995, seven years before we discovered the primary cell, we had already developed a very effective regression technique (Whole-Hearted Healing (WHH)) for healing trauma (McFetridge & Pellicer, 2004). Over time, we encountered clients with specific emotional and perceptual issues that would not heal using regression on the presenting symptoms (roughly 20% of typical client issues). Examples include feelings of loss coming from defined areas in the body, copies of other people's feelings, and many others. By trial and error, we eventually identified the indirect traumatic feeling driving each of these problem categories we called *special situations* (Courteau, 2013). However, we had no idea what was causing them. They were just observed phenomena with empirical solutions. By 2003, after we discovered the primary cell, it was tremendously exciting to find that these special situations came from specific biological problems inside the primary cell (McFetridge, 2014). It was a relief to finally have a model that explained what we saw, and it affirmed that the primary cell model was valid.

Despite this, in those first four years of working with the primary cell, our team would still sit around the kitchen table and say repeatedly, "This can't be real!" and "We must be crazy!" Our paradigm conflict of using prenatal regression and primary cell perception instead of conventional microscopy to make biological observations was strong. Acceptance only came gradually from innumerable observations, predictions that worked, verifiable therapeutic results, and much time. Eventually, we fully accepted the primary cell model and the subcellular psychobiology theory that was built on it.

Building the Theory: Subcellular Markers for Diagnosis and Treatment

A major issue that plagues psychiatric and psychological diagnosis and treatment is trying to identify what the patient's problem is, or if they even have a problem at all, given all the emotional noise of daily life. Fortunately, there is a simple, definitive solution by using subcellular psychobiology. When something is wrong in the primary cell, everyone feels it as if it were inside, on, or outside their physical body. However, even if a given sensation feels like it is from one's body (such as pressure or pain), some sensations are unmistakably subcellular. For example, one might experience a sensation akin to a bottomless black hole in the body, perceive a part of their body to be missing, experience bubbles protruding out of the body, or notice sucking sensations along their midline, and the list goes on. We call these unusual sensations, often accompanied by a visual component, *subcellular markers*.

Since, in our experience, psychological disorders are caused by physical, biological problems inside the primary cell, specific subcellular markers will uniquely identify the disease. These markers are not subtle – if a client has one, they can immediately describe it when asked an appropriate question. However, because the marker sensations make no sense from our normal ideas of what the body should feel like, clinicians (and clients) ignore this data. After all, who wants to seem crazy? These markers also let us know when healing is complete—the disorder is gone when the marker is gone. Part three of this paper will give treatment examples using this powerful concept of subcellular kinesthetic markers.

Finally, astute readers may have already spotted this model's most important use, finding the causes (and treatments) for diseases of unknown etiology. The model says that all disorders and diseases can only exist because of underlying problems in the primary cell. With training, one can search the primary cell for the pathogen or damage that causes the symptoms. Prenatal regression is then used to find the moment when the problem first started. At that point, a variety of treatment options become possible.

The subcellular psychobiology theory is a boon to psychology (and, interestingly enough, to spirituality), as many mysterious problems sometimes encountered with existing techniques can now be understood and treated as primary cell issues. It is as if we have all been trying to fix the dense smoke from our car's muffler by working on the muffler instead of the engine where the problem lies.

Building the Theory: Trauma Results from Epigenetically Inhibited Gene Expression

What might come as a surprise is that no one knows why effective trauma therapies work on post-traumatic stress disorder (PTSD) or why talk therapy does not. To give perspective, before 1996, PTSD was considered incurable. That year, a groundbreaking article in the *Family Therapy Networker* (now *Psychotherapy Networker*) was published that described treatment modalities (e.g., EMDR) that cured PTSD (Wylie, 1996). What made this credible was that Dr. Charles Figley, a Florida State University professor and the person who first coined the phrase PTSD, described the stunning results of tests he ran using these therapies (Carbonell & Figley, 1999). Now, many practicing therapists routinely use these therapies (or more recent variations) with great client success. However, conventional psychological models cannot explain how they work. Regardless, these therapies work extremely well, and they work fast.

Conventionally, trauma is assumed to be somehow stored in the brain. Yet, trauma therapies eliminate the painful feelings but leave the memory of the event intact, suggesting two *different* storage mechanisms. Based on our work with the primary cell, we have found that trauma feelings are an intracellular problem. In this section, we explain how trauma feelings are present in ribosomes and how vulnerability to trauma is caused by epigenetic damage. From an application viewpoint, we show how trauma therapies heal trauma and repair epigenetically inhibited gene expression simultaneously. In fact, some of the most useful subcellular psychobiology techniques turn out to be trauma therapies.

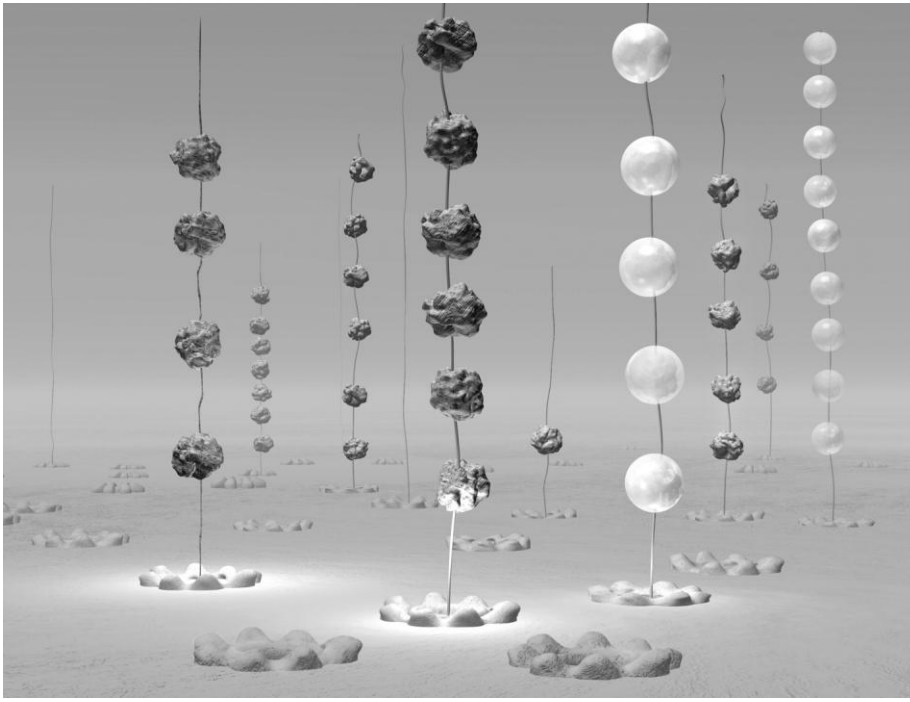
Trauma and Subcellular Biology

To grasp the connection between trauma and intracellular biology, we will revisit our early primary cell experiment where we pulled what looked like seaweed out of the sea floor, and traumatic feelings would vanish (Lykkegaard et al., 2024). (Note: this action damages the nuclear membrane). When we focus on the primary cell, we normally find ourselves floating in a light gray fog (the cytoplasm). However, if we think about a traumatic memory, we instantly find ourselves hanging beside what looks like a crumpled-up paper bag (a ribosome) also floating in the fog. This ribosome has a thin string (mRNA) running through it, with other ribosomes attached like beads on a string (Figure 1). When we look at these other ribosomes, each triggers a different traumatic

memory with the same emotional tone. These trauma events are arranged chronologically, the earliest at the sea floor (the nuclear membrane) (Figure 2).

Figure 1

3D Artist Drawing of Stuck mRNA Strings



Note. An artist's approximation of trauma strings in the primary cell. Stuck mRNA strings stick out of nuclear pores on the nuclear membrane, looking like seaweed from the sea floor. mRNA strings with ribosomes attached cause biographical trauma, and mRNA strings with spherical balls cause generational trauma. (Image: Piotr Kawecki)

This pattern of traumas was familiar to us from another context. In the field of trauma psychology, a surprising phenomenon has been observed by trauma therapists for many decades but with no biological explanation. When a person experiences painful, traumatic feelings, there is a serial (stacked) nature to trauma, where a presenting trauma will trigger earlier traumatic moments that have identical sensations and emotions. Examples of trauma therapies that recognize this phenomenon include Holotropic Breathwork (Grof, 1985), Traumatic Incident Reduction (TIR) (French & Harris, 1999), and Whole-

Hearted Healing (WHH) (McFetridge & Pellicer, 2004). We had accidentally stumbled upon the subcellular psychobiology reason for this empirically observed pattern of stacked trauma events.

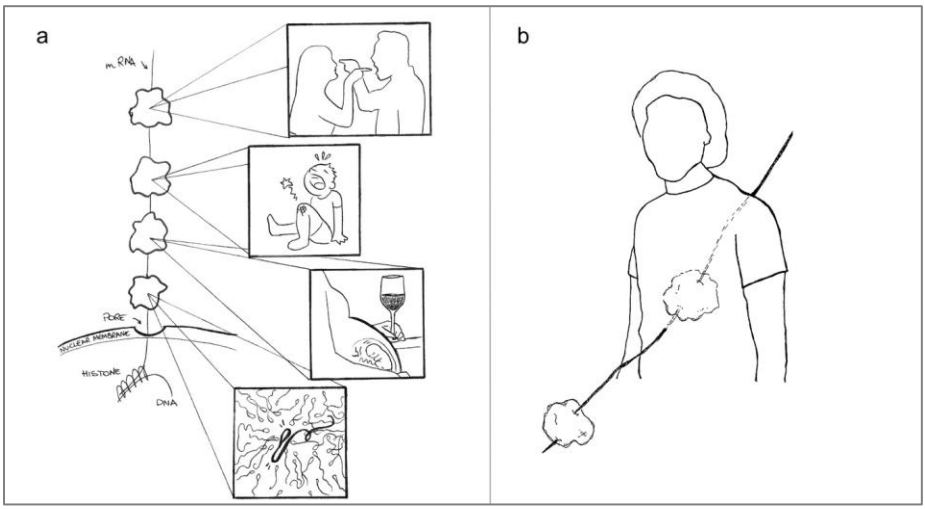
We observe that access to a trauma experience is found inside ribosomes. In other words, stuck mRNA strings with attached ribosomes and stuck traumas are two sides of the same coin. However, why are these mRNA strings present at all? Let us briefly review what happens during normal gene expression when a protein is needed. A gene unrolls from its tight histone-packed form (chromatin), and an mRNA copy is made (transcription). The mRNA string goes out a nuclear pore into the cytoplasm, where a floating ribosome attaches to one end of the mRNA string and reads along it like a ticker tape. This gives the ribosome the pattern to make a protein (translation), and when the task is finished, the ribosomal complex dissociates, releasing the protein. Ribosomes continuously attach to the string like an assembly line (a polyribosome). When enough proteins are made, the mRNA string dissolves.

We observe that the stuck mRNA strings arise from disrupted gene expression. When the mRNA string copy is nearly complete, the transcription stops because the end of the mRNA string inside the nucleus stays stuck to damaged (ripped, torn, shriveled, or coated) material on the surface of the gene. Despite this, the other end of the mRNA string stretches out through a nuclear pore into the cytoplasm. Ribosomes still attach and move down the string but stop because the nuclear membrane or other ribosomes are in the way. Instead of dissolving and starting anew, the entire structure locks up. Most of these stuck strings form just after conception.

Thus, damaged material on the surface of the gene is the culprit responsible for the cascade of events resulting in a stuck mRNA string of ribosomes (which is experienced as a sequence of traumatic memories). The emotions and sensations of trauma are sourced in this damaged material and flow up the mRNA string to the ribosomes. The ribosomes only act as gateways to the non-feeling (factual) content of the event memory (Figure 2). The traumas on a string are those moments when the cell needed the inhibited protein to respond properly but could not.

Figure 2

Sketch of a Stuck mRNA String with Attached Ribosomes



Note. a. Each ribosome corresponds to a traumatic incident, each with the same emotional content, going back through time. b. The sensation of a triggered ribosomal trauma string from the primary cell superimposed on the body. Location and size can differ. (Drawings: McFetridge, 2014)

Trauma Therapies and Epigenetic Damage

We can now understand the subcellular psychobiology of how trauma therapies work. When healing trauma, we observe the following sequence: the damaged coating undergoes repair; this releases the stuck mRNA string with its attached ribosomes; the string then floats upwards into the cytoplasm, where it breaks down, eliminating the associated trauma feelings. However, we have observed that different trauma therapies exploit different metabolic pathways to eliminate symptoms, ranging from repairing the underlying coating damage (e.g., EMDR, WHH, Emotional Freedom Technique (EFT)) to inhibiting trauma access but leaving the stuck mRNA string intact.

This damaged material on the DNA surface is an epigenetic inhibitor of gene expression, and so far, we do not know what the damaged material is. It could be histone protein, regulatory RNA molecules, DNA methylation, or other unknown epigenetic molecular material. Using regression, we found that the damaged material on the genes is inherited, and vulnerability to trauma is

thus a biological pre-existing condition. Unfortunately, a typical person has a lot of these damages.

Thus, from a disease treatment perspective, we can use simple trauma-healing techniques to target and repair epigenetically inhibited gene expression. Since the primary cell sets a dynamic pattern for all other cells, this also means this repair almost instantly echoes out into making the same repair in every relevant cell in the body. This vastly simplifies therapeutic intervention, as all we have to focus on is the damage inside just one cell, not intracellular damage scattered haphazardly throughout various body cells.

Epigenetic Damage Causes Three Different Types of Traumas

Our original regression trauma therapy identified three different types of trauma, along with specific protocols to treat them (McFetridge & Pellicer, 2004). We observe in the primary cell that each type corresponds to a specific variant of epigenetically inhibited gene expression:

1. **Biographical Trauma:** This is the most recognized trauma type (PTSD is the extreme example) and was described in the previous section as traumatic memories. Experientially, biographical trauma causes a person to have stuck beliefs and responses to life events. In the primary cell, stuck mRNA strings come out of a nuclear pore with ribosomes (looking like crumpled paper bags) attached along its length. These traumas affect cell activities and communication.
2. **Generational Trauma:** This is called *transgenerational epigenetic inheritance* in the literature. Experientially, generational trauma causes a person to feel personally and fundamentally defective. In the primary cell, this type of trauma also has stuck mRNA strings coming out of a nuclear pore, but with the ribosomes replaced by spherical balls (we do not know what these balls are) with a size similar to ribosomes. These traumas all affect the way the cell is built.
3. **Body Association Trauma:** Examples are Pavlov's dog or Robert Ader's initial psycho-immunology experiment that linked a taste to immune system function (Ader & Cohen, 1991). Experientially, body association trauma causes different feelings (sensations or emotions) to link in completely illogical associations. In the primary cell, associational traumas are structurally different from the other two types: the mRNA string from a stuck gene in the nucleus is still present,

but the mRNA string runs up a tube in the endoplasmic reticulum (ER), with attached ribosomes embedded in pores in the rough ER. Associational traumas all affect cell metabolism.

Why does epigenetically inhibited gene expression show up in three different ways? We believe that Margulis' endosymbiosis theory of the evolution of eukaryotic cells provides the answer (Margulis, 1992). According to her theory, different early bacterial ancestors of the eukaryotic cell combined and stored their genes in the nucleus (except for a few genes in the mitochondria). As each of these primordial bacteria contributed different intracellular functions, it would make sense that epigenetic damage to their genes would cause very different functional problems.

How Do Our Observations Fit with Current Biological Models?

Since we made our observations using prenatal regression and perception of the primary cell interior instead of microscopy or lab assays, we looked to the molecular biology literature to support or disagree with our findings. To our surprise, fascinating experiments with animal models had already demonstrated that trauma is an intracellular phenomenon not dependent on neural brain networks. Bédécarrats et al. (2018) showed that trauma memory (from electrical shock) in sea slug *Aplysia* is carried in RNA extract and can be transferred to non-traumatized sea slugs. Similar experiments in *planarians* using various extracts had the same effect (Gold & Glanzman, 2021). "Many of these studies performed on a variety of organisms, including flatworms, goldfish, and rats, reported positive transfer of memory; in addition, there were reports of successful cross-species transfer of memory via injection of RNA or brain extract" (Gold & Glanzman, 2021).

Our observation that epigenetic inhibition of gene expression is paired with trauma has also been experimentally verified (Jarwaid et al., 2018; Roth et al., 2015; Uddin et al., 2010), with these epigenetic changes being transgenerationally inheritable (Dias & Ressler, 2013; Pembrey et al., 2006). Our finding that an intervention on either gene inhibition or trauma fixes both has also been observed experimentally. Using a chemical compound, fear was extinguished in traumatized rodents by disinhibiting gene expression by increasing histone acetylation (Whittle & Singewald, 2014). Using trauma therapy, EMDR reversed epigenetic DNA methylation marks in people with PTSD (Vinkers et al., 2019).

Safety Issues in Subcellular Psychobiology Research

It was not until 2014, twelve years after the discovery of the primary cell, that we published our first subcellular psychobiology desk manual for therapists (McFetridge, 2014). It took us this long to solve the major safety problems we had found and to have enough years of testing on the tools and techniques to trust they were safe for publication. However, doing new psychobiology research remains inherently high risk, as it can trigger unexpected emotional or physical problems. A good way to visualize this is to imagine that there are events in prenatal development or situations in the primary cell that can sit there like dormant landmines but, when examined, are set off. Since new psychobiology treatments or techniques use cues to trigger specific prenatal developmental events that a client would not normally access, they have to be tested for unexpected problems. Some examples:

- The cord-cutting trauma at birth can sometimes trigger suicidal feelings and actions.
- A particular developmental event in the primordial germ cell formation can trigger a severe, debilitating inability to focus attention (attention deficit disorder).

These rare problem developmental events can be dealt with if they are recognized and managed as part of the treatment protocol. Fortunately, ordinary regression on client symptoms does not generally pose this risk since the client is already living with their prenatal event trauma symptoms.

After the research phase, all new techniques and processes must be safety tested. Like drug testing, you look for rare or unexpected problems in larger populations. Thus, we routinely do in-house phase 1 and 2 clinical trials. For example, we look for:

- new symptoms that only show up days or weeks after treatment;
- compensation problems due to changing intracellular homeostasis;
- unexpected problems from not finishing a treatment.

Yes, research into subcellular psychobiology has risks, but this is not the whole picture. To give perspective, once these new, powerful psychobiology processes are optimized and tested, they are extremely safe and effective, allowing therapists to quickly and easily heal client problems that have previously been incurable.

Summary of the Subcellular Psychobiology Theory

The subcellular psychobiology theory is built on the primary cell model's existence and properties. The theory explains how psychological phenomena arise inside this cell, how to find the causes of psychological disorders and other diseases of unknown etiology, and how to design trauma psychobiology techniques to modify the cell interior to treat disease.

Key points:

- Our everyday experience is a mixture of sensations, feelings, and perceptions from the body, along with ones inside the primary cell.
- The primary cell cannot easily discriminate between sensations from inside itself and sensations from the body.
- Biological problems in the primary cell are experienced as physical and psychological symptoms (emotions, sensations, and perceptions) inside, on, or outside our physical body.
- Primary cell diseases or disorders create unique symptoms we call subcellular markers, which can be used to diagnose and target treatments.
- Biographical, generational, and associative trauma healing can be used to eliminate epigenetically inhibited gene expression.
- Effective psychological trauma techniques work by interacting with the intracellular biology inside the primary cell.
- New psychobiology techniques can be designed to interact with and repair the primary cell, automatically affecting all relevant cells in the body.
- Symptoms from an intracellular pathogen can be greatly reduced or eliminated with simple targeted trauma healing.
- We can repair damage or infections in the body by fixing the primary cell's underlying vulnerability.
- The causes of mental and physical diseases of unknown etiology can be found in the primary cell.
- Psycho-immunology techniques derived from subcellular psychobiology theory can eliminate targeted pathogen species (beyond the scope of this paper).

Conclusion

The subcellular psychobiology theory provides a novel framework for understanding how psychological techniques modify intracellular biology. By targeting epigenetically inhibited gene expression, we can develop effective treatments that address the root causes of psychological disorders. This paper barely touches the edges of all the extraordinary implications of the subcellular psychobiology theory. It is a basic building block for understanding and solving many fundamental problems and questions of humanity, the world, and our place in it. Applications range from consciousness research, spirituality, religion, and exceptional states of consciousness to psychological disorders, diseases of unknown etiology, medicine, drug development, and cell and developmental biology. After two decades of using this theory in research, therapist training, and client treatment, we believe it is time to introduce it to a larger scientific audience to encourage a robust debate and further investigation.

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Addressing Neonatal Abstinence Syndrome: Current Interventions and Future Perspectives

Kelsey Lunsford, MA

Neonatal Abstinence Syndrome (NAS) is a condition that affects newborn babies exposed to drugs in utero, resulting in withdrawal symptoms shortly after birth (Stanford Medicine, n.d.). Approximately 80 babies are born every day with NAS, equaling one baby every 19 minutes (Centers for Disease Control and Prevention [CDC], 2025). The number of babies born with NAS is rising. In fact, between 2010 and 2017, cases of NAS surged by 82% nationwide. These increases were seen across the US, in nearly every state and regardless of demographic group (CDC, 2025). In 2019, 7% of mothers reported that they were using prescription opioids during pregnancy. Of that 7% of expectant mothers, 1 in 5 disclosed that the prescription medication they were using was not prescribed by a physician (CDC, 2025). Noteworthy, these figures are from self-reported data, which suggests that the number of expectant mothers using and abusing prescription pain medication during the gestation period could be significantly higher. Despite most NAS cases being caused by opioids, this condition can also sometimes be caused by other substances like antidepressants, barbiturates, benzodiazepines, or marijuana (March of Dimes, 2019).

Neonatal abstinence syndrome has a range of symptoms, primarily affecting the nervous system and the gastrointestinal system. Symptoms range from mild to severe and can include, but are not limited to, fever, high respiratory rates, sweating, weight loss, projectile vomiting, poor feeding, loose or watery stools, tremors, sleep disturbances, myoclonic jerks, and seizures

The author has no conflicts of interest. Kelsey Lunsford, MA (ORCID: 0000-0001-6974-5834) is a health communication scholar at the University of Florida whose work examines the impact of interpersonal relations on health outcomes. More specifically, her research focuses on identifying gaps in patient care and implementing behavioral or communicative strategies to improve health outcomes. Her areas of focus are maternal-child health, women's health, chronic illnesses, and oncology. Send correspondence to kelseylunsford@ufl.edu.

(McQueen & Murphy-Oikonen, 2016). The signs of NAS and the severity of the condition depend on factors such as how much of the drug was used during pregnancy, how long the drug was used, how the mother's body breaks down and responds to the drug, and the gestational age at which the baby is born (March of Dimes, 2019). The withdrawal symptoms in the baby can appear as soon as 24 hours after birth but may not show until up to 10 days after birth (Stanford Medicine, n.d.). NAS can be attributed to other complications like low birth weight, jaundice, sudden unexpected infant death syndrome (SUIDS), preterm delivery, and abnormal heart patterns. In severe instances of NAS, the baby may need to be admitted into a newborn intensive care unit (NICU) (McQueen & Murphy-Oikonen, 2016).

It is imperative to treat NAS immediately following the birth of a baby; therefore, timely diagnosis of the condition is vital. The most common way to assess the severity of NAS is through verbal disclosure from the mother; however, this method is not always plausible. Sometimes, testing of the infant is necessary to determine the prevalence of NAS and the extent of the risk. The Finnegan Neonatal Abstinence Scoring System (FNASS) is the most widely adopted assessment scoring for NAS. This assessment scores 21 signs and symptoms of NAS, divided into three categories (Mehta et al., 2013). Though FNASS has been modified and improved several times, the assessment still has limitations, such as inter-rater variability, as some of the scored signs are subjective (Anbalagan & Mendez, 2022). Since the creation and adaptation of FNASS, other scoring tools have been created, like the Neonatal Withdrawal Inventory (NWI) and the Neonatal Narcotic Withdrawal Index (NNWI). Although these other measures have addressed the shortcomings of FNASS, they have not been widely implemented in hospitals nationwide for unknown reasons (Grossman & Berkwitt, 2019; Mehta et al., 2013).

The treatment for NAS can vary but will typically include medications to alleviate withdrawal symptoms (e.g., morphine, methadone, and buprenorphine), IV fluids to prevent dehydration (from excessive vomiting or diarrhea), and feeding the baby higher-calorie baby formula (March of Dimes, 2019). Neonatal mortality because of NAS is low, and most babies will recover within 5 to 30 days. However, some drugs, like heroin, can cause withdrawal symptoms in the baby for up to 4-6 months (March of Dimes, 2019; Stanford Medicine, n.d.). Most babies born with NAS have to stay in the hospital for 11 days on average, compared to two days for babies born without the condition. This extended stay in the hospital can make the cost of the stay nearly eight

times the price of a standard newborn hospital stay—on average, the price of a hospital stay with a newborn with NAS is around $8,000. In contrast, a hospital stay for newborns without NAS is around $1,100 (CDC, 2025).

Although the condition has a very high survival rate, it is important to know that the long-term effects of NAS are still unknown. It is thought that NAS could lead to developmental delays (i.e., motor issues or behavioral issues), nutritional or growth issues, hearing or vision impairment, or both (March of Dimes, 2019). Additionally, babies with NAS are more likely to misuse and abuse harmful substances as they grow older into adulthood. Numerous societal and environmental factors can explain potential long-term effects, so more research needs to be done to pinpoint the exact long-term effects of NAS. However, it is recommended that all babies who had NAS receive routine follow-up exams with physicians to be able to determine any side effects after recovery (McQueen & Murphy-Oikonen, 2016).

Extent of the Problem and Need for Action

NAS within the United States is not a new discovery. The first case of NAS dates to 1875, shortly after the introduction of opium in the country. The term opioid was not introduced in the United States until the late 1950s, and it was used to refer to synthetic narcotics in general (Gomez-Pomar & Finnegan, 2018). Since the introduction of opioids in the country, the use and subsequent abuse of the substance have been on the rise. The use of opioids has also been increasing for pregnant women, too. In the 15 years between 1999 and 2014, the use of opioids during pregnancy increased by 333%, and, as a result, the number of cases of NAS has increased, too (Anbalagan & Mendez, 2022).

Today, the number of babies born with NAS is incredibly concerning, especially because the condition is preventable. The only way to prevent NAS is for the baby not to develop the addiction while in the womb; thus, the mother needs to stop using substances before pregnancy or immediately after she finds out she is pregnant (Stanford Medicine, n.d.). It is important to note, though, that it is not easy, nor is it recommended, for mothers to stop taking the medication. Rather, expectant mothers should consult with a medical professional to discontinue the drug safely to protect the well-being of both the mother and baby (March of Dimes, 2019).

Every state in the United States has cases of NAS; however, not every state has laws mandating NAS occurrence reporting (Jilani et al., 2022). As of 2018,

only Arizona, Florida, Georgia, Kentucky, Tennessee, and Virginia have laws that mandate NAS case reporting (Jilani et al., 2019). NAS reporting is advantageous in identifying problem areas within each state where cases are especially high and determining the effects of NAS on the community (Jilani et al., 2022). Despite the lack of laws mandating reporting, many states still take count of NAS incidences. A study of 47 states revealed that cases of NAS were most prevalent in Maine, Delaware, West Virginia, Vermont, and Kentucky (Hirai et al., 2020). Unfortunately, because reporting of NAS is not standard across the country, it is difficult to target areas where it occurs specifically. It is recommended that further research and standardization be done across the country to identify and respond to cases of NAS accurately. Research regarding NAS is being conducted globally but is concentrated within the United States (Zyoud et al., 2022).

Although NAS has been a global concern for decades, it remains understudied and continues to rise in prevalence. Because of the uncertain long-term effects of the condition on children and its preventable nature, it is crucial to address it by focusing on reducing opioid and other substance abuse among expectant mothers. Failure to address the issue jeopardizes the lives of more newborns.

Social Ecological Model

The social-ecological model approaches public health holistically, emphasizing the multiple factors that can influence public health and specific public health issues. The model encompasses physical, mental, and social well-being when conceptualizing health (CDC, 2022b). It has gained widespread acceptance across various disciplines, with many state, national, and international public health organizations utilizing this framework in their policymaking (Golden & Earp, 2012). The core principles of the social ecological model (Lee et al., 2017) include:

> (1) there are multiple influences on an individual's behaviors, including factors at the intrapersonal level, interpersonal level, with increasing influence at levels of organization, community, and public policy; (2) influences interact across these different levels or spheres of influence; (3) use of this model should be applied to specific behaviors; and (4) multilevel approaches can be the most effective interventions for changing behaviors. (p. 299)

The social ecological model has five levels. The first level of the model is the individual level, which identifies biological and personal historical factors that may contribute to the health problem (e.g., age, race, gender). Next, the interpersonal level includes the support system surrounding the individual, like friends and family members. Third, the organizational level addresses the entities that regulate a person or group of people. The community level is the fourth, which constitutes the relationships between organizations. Finally, the fifth level is public policy, which refers to the laws that government organizations enact.

Epidemiology of NAS

To understand what causes NAS, we must look first at its root cause, which is substance (opioid) abuse during pregnancy. If we address NAS as a public health issue, we must examine the reasons and circumstances that lead mothers to abuse opioids and investigate the factors that contribute to the continuation of this abuse throughout their pregnancy. Precursors of NAS are discussed below.

Socioeconomic and Environmental Conditions

Recent literature shows a link between socioeconomic challenges and NAS in infants. Specifically, individuals in rural or unsafe neighborhoods often face limited quality healthcare. Patrick et al. (2019) found that inadequate access to mental health services increases the risk of drug abuse during pregnancy, subsequently heightening the risk of NAS in newborns. Without adequate access to mental health services, expectant mothers are struggling to take proper care of themselves, which increases the likelihood of engaging in harmful behaviors that affect both themselves and their babies. Enhanced access to mental healthcare could encourage better utilization of services, ultimately improving maternal health and birth outcomes.

Furthermore, lower-income expectant mothers typically rely on government programs, like Medicaid, for healthcare. Women of childbearing age and pregnant women under Medicaid more frequently fill opioid prescriptions compared to those not covered under the program (Moore et al., 2018). They are more likely to abuse the drug during their pregnancy, thus putting them at a higher risk of their infant being born with NAS. Approximately 80% of NAS births are covered under Medicaid (Winkelman et

al., 2018). However, treatment outcomes for NAS under Medicaid have shown to be less successful. Winkelman et al. (2018) found that infants born and treated under Medicaid were more likely to be transferred to another hospital and stay longer than those covered under private insurance.

Living and Working Conditions

A study by Patrick et al. (2019) found that babies born in areas with higher long-term unemployment rates were at higher risk of being born with NAS. This finding highlights the impact of socioeconomic struggles and the lack of adequate healthcare. Mothers who give birth to an infant with NAS are also more likely to be living in unstable housing, which is further exacerbated by the higher rates of sexual abuse that mothers with opioid abuse behaviors experience (Substance Abuse and Mental Health Services Administration, 2016).

Living and working conditions for expectant mothers with opioid abuse history are subpar and pose significant risks for both maternal and infant health. Addressing socioeconomic and environmental factors is essential for improving outcomes during pregnancy and delivery.

Family, Social, and Community Influences

Regardless of socioeconomic background or personal history, expectant mothers with opioid use disorders are at a greater risk of having a poor support system. Additionally, pregnant women with opioid use disorders are at a greater risk of experiencing interpersonal violence—whether from a spouse, family member, or close friend (Substance Abuse and Mental Health Services Administration, 2016). With better support systems in place, expectant mothers may be more motivated to seek treatment for their substance abuse, thereby reducing the risk of their infants developing NAS. Understanding interpersonal influences is especially important when assisting the mother and baby in the gestation period and the postpartum stage. By intervening and providing mothers with reliable sources of support, we can reduce the risk of substance abuse and relapse.

Individual Lifestyle Factors

Expectant mothers with a substance abuse history face a societal stigma. Because of this stigma, they are less likely to seek treatment for their substance abuse. The stigma can be traced back to poor social support but also the history of treating drug addicts as less than others within society. We must reduce the stigma surrounding substance abuse to empower these women to seek treatment. Intervention is necessary to motivate pregnant women at risk of continued substance abuse to take action to improve the health of themselves and their babies, regardless of existing stigmatization.

Additionally, pregnant women with an opioid abuse history are at a greater risk of poor nutrition. Nutrition is just one way expectant mothers can be mindful of their habits to improve birthing outcomes; however, it is often neglected. Those with a lower income typically have fewer resources and, as a result, they are more likely to make more unhealthy choices. Interventions to promote a healthy diet among mothers may motivate them to take better care of themselves through their pregnancy and into the postpartum stage.

Mothers of babies born with NAS are more likely to have a history of unpredictable parenting models, which puts the infant at an increased risk after birth. It is imperative to intervene to address proper parenting techniques and habits to ensure the baby's safety. Educating mothers and highlighting the importance of care for the baby can make them better equipped to manage parenting challenges. Furthermore, pregnant women with opioid use disorders frequently face co-occurring psychiatric disorders, complicating treatment (Substance Abuse and Mental Health Services Administration, 2016). They can be in denial about the need for treatment or resist treatment altogether (Substance Abuse and Mental Health Services Administration, 2016). Educating them about the importance of seeking help could change health behavior and improve health outcomes.

These lifestyle factors, if not managed, can lead to greater access to illicit drugs and, thus, a greater chance of the infant developing NAS. Additionally, with access to illicit drugs comes a fear of legal repercussions. These mothers are at a heightened risk of facing legal consequences because of consuming these substances. In some situations, if an expectant mother already has children, she could be at risk of losing custody of her children.

Innate Factors

The severity of NAS is influenced by genetic variants in opioid receptor and stress response genes (Wachman & Farrer, 2019). The genetic response can determine how long the recovery time and hospital stay for NAS is. Additionally, the infants of White women most experience NAS. A 2015 study showed that per 1,000 births, the rate of non-Hispanic White women giving birth to an infant with NAS was 10.1. This rate is nearly five times higher than any other race or ethnicity (Healthcare Cost and Utilization Project, 2015).

Interventions

Current interventions for NAS target preventing or treating drug addiction in the mother before the baby is born. Pharmacotherapy for opioid use in pregnant women has been the most successful intervention. The standard of care for over 20 years has been methadone treatments (National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction, 1998). More recently, however, buprenorphine has shown promising results. A clinical trial conducted between 2005 and 2008 demonstrated that babies born with NAS whose mothers received treatment of buprenorphine compared to methadone required shorter treatment duration, shorter hospital stays, and less medication themselves (Substance Abuse and Mental Health Services Administration, 2016). Still, these two drugs are considered Category C5 drugs by the FDA, meaning there are not sufficient studies demonstrating how these drugs impact pregnant women.

Though pharmacotherapy has shown itself to be beneficial for both the mother and baby, it is not without its limitations. Some women who undergo pharmacotherapy will want to try a medically supervised withdrawal. However, this approach is not recommended. Remaining on pharmacotherapy will produce the best outcomes for both the mother and baby. This is the recommended method as, should a mother choose to taper off or withdraw, even with medical supervision, there is a high failure rate, and these expectant mothers often return to misusing drugs during their pregnancy (American Society of Addiction Medicine, 2015; Jones et al., 2008).

Additionally, despite the success of pharmacotherapy, many mothers still face an unmet need for long-term care and recovery from the addiction (Chang et al., 1992). Still, despite the limitations of pharmacotherapy, the success of the intervention keeps it at the forefront. It is noteworthy that pharmacotherapy

does not necessarily ensure that the baby will be born without NAS. The intervention, however, will reduce the severity of the baby's condition. Patient-provider communication during this intervention is vital to ensure that mothers follow the appropriate care plan. Reassurance of safety is necessary as the dosage of the pharmacotherapy will be altered throughout the intervention. It is important to remind mothers that the dose of the pharmacotherapy will not affect the incidence or degree of NAS for the baby (Substance Abuse and Mental Health Services Administration, 2018). Aside from pharmacology, non-pharmacologic approaches have been considered, but only to treat chronic pain for the general population more broadly (Agency for Healthcare Research and Quality, 2022).

The Substance Abuse and Mental Health Services Administration (SAMHSA) created a model in which interventions are implemented at each stage to reduce the risk and potential harm of substance abuse exposure in the prenatal and postpartum stages. The Substance-Exposed Infants (SEI) outlines five stages in which intervention should occur: pre-pregnancy, prenatal, birth, neonatal, and throughout childhood and adolescence. The pre-pregnancy stage focuses on education. This stage includes promoting awareness to women of childbearing age and their families about the dangerous effects that substance use during pregnancy could have on infants. In the prenatal stage, interventions include screening pregnant women for signs of substance use and referring them to specific treatment centers if needed. For the birth stage, healthcare providers should be testing newborns for prenatal substance exposure immediately after delivery. Tests such as FNASS can be used to test for NAS. Next, routine assessments can be conducted in the neonatal stage to ensure the infant meets all the developmental indicators. This stage should also provide services for the newborn and the family, and interventions should ensure the family uses these services to promote healthy behaviors. In the final stage, throughout childhood and adolescence, interventions include continuing needed services for the child and their family. Each stage represents a critical point where interventions should be implemented. The SEI framework demonstrates the need for collaboration amongst organizations to support at-risk infants and families (Substance Abuse and Mental Health Services Administration, 2016).

The Children and Recovering Mothers Collaborative (CHARM) program is one example of the successful use of the SEI model. This was a multi-step intervention program based out of Burlington, Vermont. Within this program,

10 organizations collectively provide care for pregnant women with opioid disorders across Vermont. These programs provide services such as pharmacologic treatment, neonatal assessment and treatment, parent education, individual and group substance abuse treatment, residential care for mothers and infants, parent and family support, child safety assessments, child welfare services, healthcare for women in the corrections system, supplemental nutritional programs (e.g., WIC), and nurse home-visiting programs. One study tested the effectiveness of the CHARM program and found that out of the 106 CHARM infants studied, 94% were within normal limits on all developmental parameters at an eight-month check-up (Meyer et al., 2012).

Since NAS primarily affects the infant, it is particularly noteworthy to discuss interventions used immediately after birth to treat the newborn. One intervention with continuous promising results includes focusing on sensory support. Specifically, creating a quiet, soothing environment, and avoiding excessive environmental stimulation has shown to be helpful for infants with withdrawal symptoms (Sublett, 2013). Despite experts recommending placing a newborn with NAS in a dimmed, quiet space for the best outcomes, many infants with NAS are unable to receive this treatment as NICU spaces can quickly become crowded and loud, and there are seldom protected, designated spaces for neonates who may be experiencing withdrawals (Casper & Arbour, 2014). Intertwined with sensory support is the importance of swaddling. Research has demonstrated that tight swaddling is important in assisting neonates with NAS as it can prevent the infant from sudden and erratic movements, which exacerbate the withdrawal symptoms. Swaddling has also been shown to decrease the crying time for those with NAS and increase sleep quality and duration (Casper & Arbour, 2014).

Additional interventions for neonates with NAS include nutritional support. Specifically, breastfeeding can be especially helpful for both the mother and infant when available. Breastfeeding assists with bonding between the mother and infant, which can de-stress the mother while providing nutritional benefits to the baby. Also, breastfed babies with NAS are less likely to experience abuse (Sublett, 2013). Breastfed babies with NAS have also been shown to decrease the hospital stay and treatment duration. One study reported that breastfed neonates with NAS had almost 10% length of stay when compared to infants with NAS who were formula-fed (Cook & Fantasia, 2019). Unfortunately, women with a history of substance use have much lower rates of breastfeeding, usually because of time away from their infants for treatment

and less support from friends and family to encourage breastfeeding once released from the hospital (Cook & Fantasia, 2019). Many health care providers are hesitant to encourage women who had substance use to breastfeed, too; however, women who had pharmacologic intervention (e.g., methadone or buprenorphine) are safe to breastfeed as there is little risk of transmission of the drug to the infant (Sublett, 2013).

Another intervention that has gained more attention recently is the use of alternative medicine to treat infants with NAS. More specifically, one treatment that has been tested is laser acupuncture. A study by Raith et al. (2015) demonstrated that neonates who received acupuncture and morphine received less morphine and were released from the hospital sooner than infants who were only given morphine. Notably, studies like this often have a small sample size, so the results are usually not generalizable. More research needs to be done before laser acupuncture is recommended as an effective intervention.

Recommendations

Prioritizing research is essential to address the shortcomings in the treatment and response to NAS. Firstly, there is no standardized or mandated reporting of NAS incidence across the United States. Mandating NAS incidence reporting in all 50 US states is imperative to identify states with continuously high NAS rates. Furthermore, once incidence reporting becomes mandatory, it must also be standardized. Standardized reporting will allow us to identify areas with low rates of NAS, prompting a closer examination of the effective interventions in those regions. Further interventions cannot be implemented until more research is conducted to better understand NAS incidence in high and low-incidence areas and their respective current interventions.

Once more research has been conducted on this condition, access to healthcare facilities should be increased in needed areas. Many communities, especially in rural or underserved urban areas, face healthcare deserts, where access to these vital services is limited or nonexistent. Addressing these gaps is crucial for improving health outcomes and ensuring all individuals have equal access to quality care. In addition, it is important to have mental health resources available. Because substance abuse is often intertwined with psychological disorders, there should be mental health care facilities easily accessible for expectant mothers who need treatment before the baby is

impacted. For mothers with a history of substance use, timely intervention and support are crucial. The lack of accessible mental health and addiction services can increase the likelihood of NAS, leading to long-term health challenges for the baby. Healthcare providers must prioritize early screening and ensure that expectant mothers have access to resources for substance use treatment to prevent NAS and promote healthier outcomes for both mother and child.

Another much-needed recommendation is to increase training for nurses surrounding substance use and abuse. Currently, nurses often lack specific training in recognizing addiction behaviors, particularly in expectant mothers. By providing training for both current and future nurses on identifying addiction and substance abuse behaviors, they would be better equipped to recognize these signs during prenatal appointments, which could lead to timely interventions. These interventions can offer support to these mothers so that they can have a healthier pregnancy and safer delivery.

Specific to the after-birth stage, neonates with NAS need specialized spaces in the NICU where there are few environmental stimuli. Current research and previous interventions have demonstrated the need for quiet, dimmed spaces for babies with NAS to be able to recover; however, in most NICUs, there is not a designated space like this, which exposes these infants to unnecessary stimuli that prolongs their treatment time. If there is a space dedicated within NICUs across the country, NAS babies and babies born with other conditions that need a quiet space for treatment can make use of this area, which will increase the likelihood of a shorter stay in the hospital for treatment.

Looking more holistically at why and how NAS occurs, it is important that we address the needs beyond substance use. When substance abuse occurs, there are overlapping issues, like socioeconomic issues, mental health issues, or interpersonal relationship issues. If we can target areas where substance abuse is high, we can learn more about the difficulties of those who are experiencing it. The opioid and other substance crisis within the United States needs more dedicated and careful attention. Still, specific to pregnant women who abuse substances, there is often a desperate need for further interventions beyond just treating the NAS in the baby. If not carefully monitored and without adequate support, the chance of the mother returning to substances after discharge from the hospital remains alarmingly high, which demonstrates the need for further work to be done. Typically, not one single thing or event leads to a substance use disorder, so we must pay closer attention to mothers' needs

beyond treating substance abuse disorders, as their health and safety could be impacted in numerous ways.

Finally, it is important to implement an individualized approach to care. While this is much easier said than done, it is vital that healthcare providers actively try to improve patient-provider interactions to improve health outcomes as a result. By listening to patient's needs, healthcare providers can tailor interventions and treatments. Each mother-baby dyad has its own specific set of needs to maintain a healthy lifestyle. With an individualized approach to care, mothers and babies can utilize specific interventions that target their needs following treatment from the hospital. An individualized approach to care begins with training healthcare professionals on the importance of patient-provider interactions and ways that providers can probe to reach a deeper understanding of their patients individually.

Conclusion

Addressing NAS requires a multifaceted approach that combines current interventions with innovative future perspectives. The growing prevalence of NAS underscores the urgent need for responsive care and comprehensive strategies to mitigate its impact. By leveraging recent national data and exploring new avenues for treatment, healthcare providers can better support affected infants and their families. As opioid use in pregnancy remains underreported and often undertreated, it is crucial to enhance awareness, improve reporting mechanisms, and develop targeted interventions that address both immediate and long-term needs. Through continued research and collaboration, we can pave the way for more effective solutions and ultimately improve outcomes for newborns facing NAS.

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The Dirt on Hygiene: From Microbe to Modern Medicine

Jessica Steier, DrPH, Aimee Pugh-Bernard, PhD, Caleb Kramer

In 1670, Dutch cloth merchant Antonie van Leeuwenhoek peered through his homemade microscope and became the first person to observe what he called *animalcules*—tiny living creatures invisible to the naked eye (Kutschera, 2023). Although Leeuwenhoek meticulously documented these microscopic beings, he never connected them to disease. Two centuries would pass before this crucial connection was made. In the late 19th century, scientists Louis Pasteur and Robert Koch (along with many others) established what we now know as the *Germ Theory of Disease*—the revolutionary idea that specific microorganisms cause specific diseases (Blevins & Bronze, 2010). This discovery fundamentally transformed human society, launching a global campaign against these invisible enemies. Public health initiatives championed hand washing, cities built modern sewage systems, and surgeons adopted sterile techniques.

The 20th century brought antibiotics, vaccines, and antimicrobial products into our homes. We declared war on microbes, and for good reason—countless lives were saved. However, in our zeal to eliminate dangerous pathogens, we may have overlooked something vital: not all microbes are our enemies. Many are essential allies in maintaining our health. Recent research suggests that our increasingly sterile modern environment might be contributing to the dramatic

Jessica Steier, DrPH, MPH (ORCID: 0009-0008-1565-824X) is a public health expert specializing in science communication. As Founder and CEO of Unbiased Science and Executive Director of The Science Literacy Lab, she provides evidence-based, unbiased information to improve community health outcomes. Her platforms reach over 10 million monthly, delivering information with compassion and integrity. Aimee Pugh-Bernard, PhD (ORCID: 0000-0001-8253-9795) is an Associate Professor who teaches immunology and science communication across the University of Colorado (CU) Anschutz medical campus and serves as the immunology content director for the CU School of Medicine undergraduate medical curriculum. Dr. Bernard is also the Director of the CU Anschutz Basic Sciences Departments Science Communication Program and a Co-Director for the Colorado Clinical and Translational Science Institute's *Communicating Your Science to the Public* workshop series. Caleb Kramer (ORCID: 0000-0001-8318-6039) is a PhD student at the University of Missouri School of Medicine, specializing in infection and immunity. Send correspondence to Dr. Steier at jsteier@vscgrp.com and learn more at unbiasedscience.com.

rise in allergies, autoimmune disorders, and antibiotic resistance. This is the essence of what scientists call the *hygiene hypothesis*—the intriguing possibility that we might have inadvertently disrupted an ancient ecological balance critical to our immune development in our quest for cleanliness.

As a public health scientist partnering with an immunologist and translational bioscientist to co-author this article, I recognize that understanding the nuanced relationship between humans and microbes is essential for effective public health policy, especially as misconceptions about germ theory circulate widely, and some even attempt to refute this foundational concept that has saved countless lives through sanitation, vaccination, and antimicrobial treatments. This article explores the fascinating journey from our first glimpses of the microbial world to our evolving understanding of how these tiny organisms shape our health in harmful and beneficial ways. As Pasteur prophetically noted, microbes indeed have had the last word, but perhaps not in the way he imagined.

Germ Theory and a Science-based Hygiene Approach

The *Germ Theory of Disease* is simply the ability of separate organisms (e.g., bacteria, viruses, and parasites) to cause disease when introduced to a second organism, like us. This scientific breakthrough informed humans worldwide that millions of critters live on, in, and around us, many of which are capable of spelling our untimely demise. Naturally, this led society to devise ingenious methods of defending ourselves against this invisible threat. Following the work of Pasteur and Koch, global hand-washing campaigns began (and continue today), sterile surgical practices were adopted, and ethanol became a medical disinfectant of choice (Curtis, 2007; Michaleas et al., 2022). Breakthroughs began to accelerate in the 20th century, antibiotics were discovered and used en-masse, a plethora of effective vaccines were developed, and people began to adapt their behaviors and living conditions to limit their exposure to dangerous microbes (Bloomfield, 2006). In Western society, migration to urban centers and a growing association between dirt and grime with microbes and disease began to limit our exposure to all microorganisms.

Robert Koch's pioneering work with anthrax in the 1870s provided the first conclusive evidence that a specific bacterium causes a specific disease (Blevins & Bronze, 2010). Although some of these postulates are considered dated,

scientists still rely on Koch's core principles to establish causal relationships between microorganisms and disease. We must recognize the impact of germ theory and scientifically backed hygienic practices on human health. Since the late 1800s, infectious disease death rates have plummeted. Infectious disease was once the leading cause of death in the United States and is now not even in the top 10 (except COVID-19 after 2020) (Murphy et al. 2024). We have eradicated diseases that previously claimed the lives of billions and are advancing every day in the fight against infectious diseases. However, it is also important to research and recognize the potential side effects of this progress.

Hygiene Hypothesis, Old Friends Hypothesis, and Danger Hypothesis

Immunologists have proposed several hypotheses to explain the relationship between hygiene and immune function: the hygiene hypothesis, the old friends hypothesis, and the danger hypothesis. The *hygiene hypothesis* suggests that fewer infections in childhood may increase our susceptibility to allergic diseases by suppressing the development of the immune system (Strachan, 1989). Over the years, research has shown that while viruses generally worsen or contribute to immune diseases, exposure to certain bacteria, especially the beneficial ones (called commensals), is crucial for a healthy immune system. About half of the cells in our body are bacterial, and these commensal bacteria that live within us help develop our immune systems (Sender et al., 2016).

Extreme cleanliness, like sanitizing every surface, may hinder immune development through decreasing exposure to environmental factors and a diverse array of microbes, including beneficial bacteria. In fact, some think that without this exposure, the immune system may become overly sensitive or hypersensitive (the actual scientific term for allergies) and react to harmless substances. Factors like cesarean sections, which limit exposure to the mother's beneficial bacteria, and diets low in fiber, which good bacteria need, also impact immune health (Dominguez-Bello et al., 2019). Living on farms or having pets can expose us to beneficial bacteria, supporting a healthy immune system. For example, owning a pet in early childhood has been shown to be protective against allergies and other immune diseases (Hesselmar et al., 2018).

The *old friends hypothesis* suggests that our immune systems need exposure to certain microbes, which humans have co-evolved with over thousands of years, to function properly (Rook, 2010). These old friends

primarily include bacteria that have been common in our environment throughout history. Without regular contact with these microbes, our immune systems may become overactive, leading to allergies and asthma. The underlying idea is that these microbes help train our immune systems to distinguish between harmful and harmless matter. The old friends hypothesis is widely regarded as the most compelling explanation for the connection between bacterial species and the immune system.

The *danger hypothesis* proposes that the immune system is primarily activated by signals from damaged or stressed cells rather than by the presence of foreign substances alone (Matzinger, 2002). According to this hypothesis, the immune system responds to danger signals released by cells when they are injured or under threat, such as during an infection or tissue damage. This helps the body focus its immune response on actual threats that could cause harm rather than reacting to harmless substances such as old friends or commensal bacteria inhabiting our bodies. By understanding the danger hypothesis, we can see how the immune system is designed to protect us by targeting real dangers, which helps prevent unnecessary immune reactions that could lead to allergies or autoimmune diseases.

By considering all of these hypotheses, we can appreciate the importance of balanced exposure to microbes in shaping a healthy immune system and that the immune system is geared toward detecting and responding to potentially harmful microorganisms while maintaining tolerance to beneficial ones. This nuanced understanding helps explain why not all microbes trigger immune responses and why our bodies have evolved sophisticated mechanisms to distinguish between microbial threats and beneficial microbial exposures.

Antibiotic Resistance: The Consequence of Overuse

The clearest cause-and-effect relationship exists with antibiotic resistance. Our widespread use of antimicrobials has accelerated this crisis through direct selective pressure on bacterial populations, allowing them to evolve the ability to survive in the presence of antibiotics that once resulted in their destruction. The Centers for Disease Control and Prevention (CDC, 2019) estimates that antibiotic-resistant infections affect nearly 3 million Americans annually and result in over 35,000 deaths. This demonstrates how our specific practices around antimicrobial use have concrete, measurable consequences. It is important to remember that antibiotics are only effective against bacterial

infections, not viral ones. Inappropriate use of antibiotics for viral illnesses contributes significantly to resistance development without providing any therapeutic benefit (CDC, 2019).

The Rising Tide of Modern Ailments: Understanding Complex Causes

The decades following our increased hygiene practices have witnessed a parallel trend: rising rates of allergic and autoimmune disorders, particularly in developed countries with the highest hygiene standards. Understanding these increases requires careful scientific consideration of multiple factors.

Allergies and Asthma: Complex Origins

Allergic conditions have increased dramatically since the mid-20th century. According to the CDC (Jackson et al., 2013), food allergies among children rose by approximately 50% between 1997 and 2011, while asthma now affects over 25 million Americans. This allergy epidemic displays a geographical pattern that is most prominent in industrialized nations and urban environments. A relatively famous example is the peanut allergy. Peanut allergies in the United States have increased over 3-fold since the late 1990s (Lange et al., 2021). Currently, about 2% of adults in the US have peanut sensitivities, and peanut allergies are among the most commonly fatal allergic reactions (Warren et al., 2021). In 2015, the *Learning Early About Peanut* (LEAP) study demonstrated that introducing peanut products to infants significantly reduced the risk of developing peanut allergies by over 80% (Du Toit et al., 2015). This groundbreaking research led to new guidelines recommending that infants should be introduced to peanut-containing foods as early as 4-6 months of age. These findings have revolutionized pediatric recommendations, aiming to drastically reduce peanut allergies through early exposure to induce oral tolerance (Togias et al., 2017).

Research has examined the relationship between parasitic infections and allergy development later in life. Importantly, many of the studies with humans with naturally occurring infections show conflicting results, suggesting the mechanism is likely more complex than simple exposure (McSorley et al., 2019). However, studies in mice show convincing evidence that pups born from parasite-exposed mothers were less likely to develop anaphylactic allergies (Gibbs & Fairfax, 2022; Yazdanbakhsh et al., 2002). While reduced microbial exposure appears to be one contributing factor, it is important to note that many

variables influence these trends, including air pollution, childhood exposure, dietary changes, genetic factors, and altered intestinal microbiomes. Research consistently shows that routine childhood vaccinations do not contribute to allergic disease development and that vaccinated children do not have an increased risk for allergies or asthma compared to their unvaccinated peers (Navaratna et al., 2021; Zhang et al., 2023).

Autoimmune Disorders: A Multifactorial Challenge

Over 80 autoimmune diseases, from type 1 diabetes to multiple sclerosis, are increasing in prevalence (Fugger et al., 2020). These conditions involve complex interactions between genetic predisposition, environmental triggers, and immune regulation. Research suggests that without microbial exposure to beneficial bacteria early in life, immune development may be altered. It is worth emphasizing that autoimmune disorders typically result from multiple contributing factors, particularly genetic predisposition, rather than any single cause. Despite extensive studies, no credible evidence links routine vaccinations to increased autoimmune disease risk. The timing of vaccination schedules coinciding with early childhood development has sometimes led to correlation being mistaken for causation.

What Does Evidence Tell Us?

The scientific consensus points to a nuanced relationship between our modern environment and immune health. While reduced exposure to certain beneficial microorganisms appears to play a role in these rising conditions, researchers emphasize that many factors contribute, including:

- changes in diet and food processing;
- reduced outdoor activity and connection to natural environments;
- increased air pollution and environmental chemicals;
- increases in C-section delivery and a resulting decrease in early-life exposure to microbes while exiting the birth canal;
- genetic susceptibility interacting with environmental changes.

Understanding these multiple factors helps us avoid oversimplified explanations while identifying practical ways to support immune health in our modern world. The converging evidence suggests a profound irony: our zealous pursuit of cleanliness may have compromised the health outcomes it intended

to improve. This realization has led researchers to reconsider what constitutes a healthy relationship with our microbial world.

Finding Balance: Moving Forward with Our Microbial Friends

The hygiene hypothesis does not suggest abandoning modern sanitation or returning to pre-germ theory practices. Rather, it invites a more nuanced understanding of our relationship with microbes. Research increasingly supports a targeted hygiene approach maintaining critical hygiene practices that prevent dangerous infections while allowing beneficial exposures that train our immune systems. This might include:

- encouraging outdoor play and contact with natural environments for children;
- limiting unnecessary antibiotics and antimicrobial products;
- embracing diverse, fiber-rich diets that support healthy gut bacteria;
- owning pets as beneficial sources of microbial diversity;
- maintaining traditional hygiene practices where they matter most (e.g., hand-washing during disease outbreaks, food safety).

Conclusion

Dr. Marsha Wills-Karp of Johns Hopkins reminds us, “Almost no virus is protective against allergic disease or other immune diseases. In fact, infections with viruses mostly either contribute to the development of those diseases or worsen them” (Rivers, 2022, para 5). The key distinction lies between harmful pathogens and the beneficial bacteria that have coexisted with humans throughout our evolutionary history. The path forward is not abandoning cleanliness but developing a more sophisticated understanding of which microbes we should avoid and which we should welcome. By reframing our relationship with the microbial world from one of universal warfare to selective partnership, we may find more balanced approaches that protect us from disease while supporting robust immune development. Ultimately, perhaps the greatest irony of the hygiene hypothesis is that it does not invalidate germ theory but completes it, revealing the complex ecological relationship between humans and microbes that extends far beyond simple notions of good and bad bacteria. In this more complete understanding lies the promise of healthier human-microbial coexistence.

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From Eugenics to Evidence: A Historical Perspective on Prenatal Physical Activity Guidelines and Their Present Impact on Maternal Health

Christiana Rebelle, PhD

The World Health Organization (WHO, 2018) reported that physical inactivity is a leading risk factor for chronic illness and death, particularly among women. However, decades of cautionary guidelines on prenatal physical activity (PA), unsubstantiated fears for the fetus, and cultural expectations of women have done little to encourage PA participation during pregnancy. As little as 10% to 15% of women achieve the recommended level of prenatal PA despite extensive research confirming the intergenerational benefits of being active and the importance of healthy weight gain during pregnancy (Garland, 2017; Newton & May, 2017; Santo et al., 2017).

Maternal morbidity and mortality rates are increasing across the United States, likely associated with the corresponding rise in obesity (Chinn et al., 2020), chronic medical conditions, and cesarean deliveries (Hirshberg & Srinivas, 2017). Still, provider counseling on PA is usually limited and not aligned with national guidelines (Lott et al., 2019; Whitaker et al., 2019). However, pregnant patients often want clear and specific guidance (Harrison et al., 2019). In 2020, the American College of Obstetricians and Gynecologists (ACOG) released updated guidelines that included evidence about the safety and necessity of PA during pregnancy, using the most authoritative language to date. However, generations of misguided recommendations and fluctuating guidelines have left their mark.

Christiana Rebelle, PhD (ORCID: 0000-0002-2682-2120) is a pre- and perinatal health consultant, writer, editor, and researcher with two decades of experience. She has coached pregnant women and new mothers, educated midwives and health professionals, and conducted workshops on prenatal health. Her research explores health beliefs, provider communication, and disparities in prenatal care. As Editor-in-Chief of the *Journal of Prenatal and Perinatal Psychology and Health*, Dr. Rebelle is committed to advancing health literacy and expanding the journal's impact, making it an essential resource in the field. Send correspondence to journal.editor@birthpsychology.com.

Historical Context of Prenatal Physical Activity Guidelines

While exercise is typically viewed as a matter of personal choice, personal choice has always been restricted when it comes to pregnancy. The centuries-long debate around prenatal PA has ranged from preserving a strong nation in the post-Civil War era to reducing the economic burden of poor health (Jette, 2018). In the nineteenth century, homeopathic physicians were concerned about the vitality of the upper class and advocated for the physical education of young women (only permitted for boys at the time) and participation in light gymnastics to improve American society (Vertinsky, 1986).

The idea gained support from physicians and moralists wanting to improve the White race. They used the Christian ideals of the time to strictly limit PA during pregnancy to walking, light gymnastics, and domestic duties. These limitations were believed to improve maternal capabilities and construct a "superior race" without compromising femininity or interfering with household responsibilities (Vertinsky, 1986, p. 28).

Changing Social Perceptions of Prenatal Physical Activity

Participation in prenatal PA beyond socially accepted boundaries was perceived negatively well into the twentieth century. It remained an area of contention even as women began stepping beyond the cultural gender stereotypes to pursue a broader range of goals. Dr. Bruser's (1968) critique of the arbitrary physical limitations imposed on pregnant women, combined with the Women's Liberation Movement of the late 1960s and 1970s, altered how people viewed women's bodies and prenatal exercise (Kehler & Heinrich, 2015).

Women in the United States felt a new sense of freedom and ownership of individual health, but the changes in women's societal role were happening too quickly for some. In the 1980s, many medical professionals began to speculate about possible complications that exercise during pregnancy might cause the fetus and raised concerns based on theories of the reproductive system, which had not been tested in research (Kehler & Heinrich, 2015).

The Role of Religion in Shaping Perceptions of Prenatal Physical Activity

Religious beliefs also played a significant role in shaping perceptions of prenatal PA. In the 1980s, leaders of the Southern Baptist Church felt the

Church and Southern culture were in crisis because of the rapidly shifting gender roles. They made public declarations affirming that women were to be submissive and stay home to fulfill maternal obligations, while men's roles were to work, protect, and lead (Early, 2018; Early, 2019). The primary message from the earliest discussions about women's bodies and their societal role has been that having just enough vigor to benefit others is encouraged, while too much is a challenge to the status quo and unacceptable in American culture. As Oliver & Kirk (2016) explained, "Active lifestyles widely practiced are a radical goal since it has the potential to be transformative of women's place in the gender order" (p 316).

Given the lack of science on prenatal PA, researchers and medical professionals disagreed on how much was safe. To provide clarity, ACOG published its first recommendations for PA during pregnancy in the mid-1980s, setting boundaries for active women and directing inactive women not to begin exercise during pregnancy. The guidelines advised caution and contributed to the widespread belief that pregnancy is a time for decreased PA.

The conservative guidance warned pregnant women not to reach a heart rate above 140 BPM and avoid vigorous activity lasting longer than 15 minutes (Wing & Stannard, 2016). The precaution to limit the heart rate became a widely accepted limitation for prenatal PA, which persists, even though it had no basis in empirical research (Mudd et al., 2009). It was removed from the next iteration of ACOG guidelines. If and how much pregnant women should exercise became a heavily debated topic among physicians and scientists, beginning an era of extensive research.

In the latter part of the twentieth century, researchers released dozens of scientifically rigorous studies that addressed many societal fears about PA during pregnancy. Dr. Clapp—a prominent researcher in prenatal exercise—challenged several prevalent hypotheses about how exercise during pregnancy may harm the mother and fetus (Clapp, 1990; Clapp & Capeless, 1990, 1991). Clapp and Little (1995) revealed a clear difference between the theoretical assumptions about prenatal PA and the scientific findings. Clapp's data indicated that the body's adaptations to exercise during pregnancy are beneficial and not a cause for concern. Other researchers found similar results but used more cautious language, thus perpetuating anxiety about prenatal PA.

The Impact of Historical Factors on Current Perceptions of Prenatal Physical Activity

Many researchers and physicians treated PA during pregnancy as something to be monitored and controlled rather than as a natural function of the human body. Dr. Artal (1992), a lead author of the original ACOG PA guidelines, referred to prenatal exercise as something to be prescribed to pregnant women; however, researchers and physicians could not agree on what a prescription for PA during pregnancy involved. Despite evidence to the contrary, women were often warned about the potential dangers of exercise during pregnancy rather than encouraged to participate.

Conclusive evidence for the safety of PA during pregnancy had mounted by the mid-1990s. The growing body of research was enough to sway some providers to concede that moderate PA was safe for healthy pregnancies; however, many continued to wrestle with the potential risks versus benefits (Kehler & Heinrich, 2015). As a result, ACOG (1994) released updated clinical guidance with few limitations for prenatal PA. The updated guidance may have increased awareness about the safety of moderate activity; however, limiting PA had already become the societal norm.

Since 1994, the ACOG has revised its recommendations frequently due to numerous studies supporting prenatal exercise and growing concerns over the effects of maternal obesity and chronic disease. Although perceptions of pregnant women being physically active have evolved, decades of warnings about the dangers of PA have been culturally ingrained. Modern society still perpetuates stereotypes of pregnancy as a disability and a time of rest. The safety and benefits of PA during pregnancy are clear. However, there remains a lack of public knowledge about current guidelines and inaccurate assumptions about women's bodies that inhibit PA during pregnancy (van Mulken et al., 2016).

Research shows that women who receive accurate provider advice about prenatal PA are more likely to remain active throughout pregnancy (Moore et al., 2018; Walasik et al., 2020). Unfortunately, many providers do not receive adequate medical training in PA (Dacey et al., 2014) or gestational weight gain (Murray-Davis et al., 2020), often inaccurate or insufficient counseling (Lott et al., 2019; Melton et al., 2016; Murray-Davis et al., 2019, 2020; Newton & May, 2017; Shulman & Kottke, 2016; Whitaker et al., 2016, 2019). A recent study found that women looked to their providers as the main source of support for

PA; however, provider counseling was ineffective at promoting PA and was associated with increased sedentary behavior (Rebelle et al., 2022).

Generations of prenatal PA restrictions and misinformation, combined with the lack of specific knowledge and training among providers, have contributed to the maternal health crisis in the United States. Informed providers can encourage PA by using evidence-based counseling to discuss the benefits, dispel myths, and support patients in overcoming common barriers. Ignoring the science of PA during pregnancy and the impact of historical factors is a missed opportunity to reduce inequities and improve intergenerational health.

Conclusion

Despite the growing body of research supporting the safety and benefits of prenatal PA, cultural stereotypes of pregnancy as a time of disability and rest persist. This, combined with the lack of specific knowledge and training among healthcare providers, has contributed to the maternal health crisis in the United States. Understanding the historical context of prenatal PA guidelines is essential for addressing the maternal health crisis. Providers must be equipped with accurate information and counseling strategies to encourage PA during pregnancy effectively. Ignoring the science of PA during pregnancy and the impact of historical factors is a missed opportunity to reduce inequities and improve intergenerational health.

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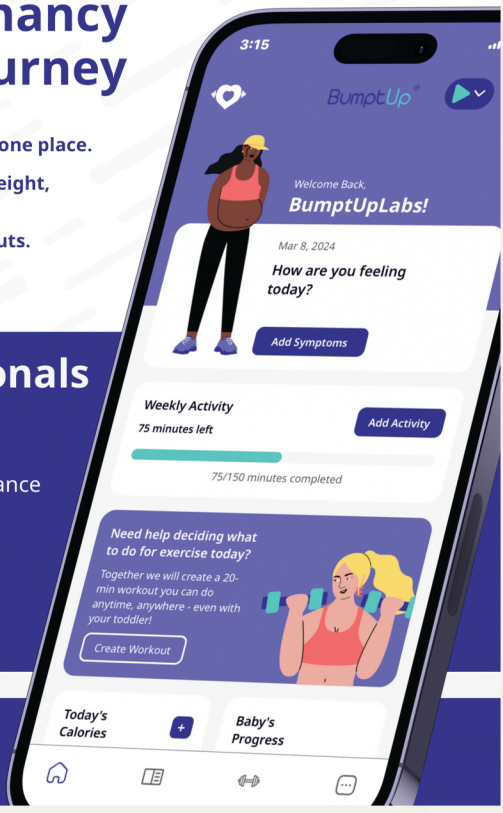

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