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SHORT COMMUNICATION

Synergistic Precision: Integrating Artificial Intelligence and Bioactive Natural Products for Advanced Prediction of Maternal Mental Health During Pregnancy

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Abstract

Background: Present-day advancements in Artificial Intelligence (AI) and Machine Learning offer promising avenues for addressing psychological health challenges in pregnant women. Despite significant strides, there remains a gap in effective, accessible and personalised interventions for managing mental health risks during pregnancy, which can have profound implications on both maternal and fetal well-being. **Aim:** This study aims to develop a predictive model for monitoring and assessing the psychological health of pregnant women. The goal is to create an accessible tool using machine learning algorithms and sustainable technologies to provide early warnings and support interventions for mental health issues. **Methods:** The research utilised a dataset comprising psychological health indicators of pregnant women, including symptoms such as anxiety, depression and sleep disturbances. Machine Learning models, including Random Forest, Decision Tree, Support Vector Machine (SVM), Logistic Regression and Gaussian Naive Bayes, were employed to classify mental health status. The models were evaluated using metrics like accuracy, precision, recall and F1-score. A web-based chatbot was developed to integrate the predictive model, providing real-time mental health assessments and personalised recommendations. **Results:** The Random Forest model demonstrated superior performance, achieving an accuracy of 92%, outperforming other models like SVM and Decision Tree, which achieved accuracies of 88% and 85%, respectively. Integrating the model into a web-based chatbot provided users with an interactive and user-friendly platform for mental health monitoring. Initial feedback from users indicated a 70% satisfaction rate with the tool's ease of use and perceived accuracy. **Conclusion:** The study successfully developed a machine learning-based predictive model for assessing the psychological health of pregnant women, integrated into a web-based chatbot. This approach offers a promising, scalable solution for early detection and management of mental health challenges during pregnancy, potentially enhancing maternal and fetal outcomes through timely interventions.

Keywords: Advanced Prediction Models, Bioactive Natural Products, Integrating Artificial Intelligence, Maternal Mental Health, Synergistic Precision

1. Introduction

Pregnancy is a critical period that significantly impacts a woman's physical and mental health. While physical changes are often closely monitored, psychological challenges such as anxiety, depression and stress are frequently overlooked, despite their profound impact on both maternal and fetal health. The stigma surrounding mental health, limited access to healthcare services and lack of personalised support contribute to the underdiagnosis and undertreatment of psychological issues during pregnancy. Currently, there is a lack of accessible, scalable, and effective tools to monitor and predict mental health challenges in pregnant women. Traditional methods of mental health assessment are time-consuming, often require clinical expertise and

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may not be accessible to all pregnant women, especially in low-resource settings. This research aims to develop a machine learning-based predictive model integrated into a web-based chatbot to monitor and assess the psychological health of pregnant women. The goal is to provide an accessible, user-friendly platform that offers early detection of mental health issues and personalised recommendations, thereby improving maternal mental health outcomes. By leveraging AI and sustainable technologies, this study seeks to fill the gap in mental health care for pregnant women, providing a proactive approach to identifying and managing psychological health risks. The developed tool has the potential to empower women with self-monitoring capabilities and timely interventions, ultimately enhancing the overall well-being of both mother and child, to identify key psychological health indicators in pregnant women using machine learning algorithms, to evaluate the performance of various machine learning models in predicting mental health conditions and to develop and deploy a web-based chatbot that integrates the best-performing predictive model, offering real-time assessments and personalised support to pregnant women. This study aims to contribute to the growing body of research on AI-driven solutions for maternal mental health, offering an innovative approach to addressing this critical public health issue. This research embarks on an exploration of the complex relationship between artificial intelligence, bioactive natural products and maternal mental health during pregnancy. The primary inquiry guiding this investigation is: How can the integration of artificial intelligence and the strategic incorporation of bioactive natural products advance the precision and efficacy of predicting and addressing maternal mental health issues during pregnancy? Navigating the realms of morning sickness, heartburn, constipation, fatigue and other common symptoms, this study seeks to explore innovative interventions that surpass conventional approaches.

The fusion of AI's analytical prowess with the therapeutic properties of bioactive natural remedies holds the promise of more personalised and effective strategies to alleviate maternal mental health challenges during this critical period. This research signifies a paradigm shift in maternal care, transcending traditional methodologies. The study's importance lies not only in its innovative approach but also in its potential to redefine the landscape of maternal healthcare. By synergising artificial intelligence and bioactive natural remedies, we aim to enhance the precision of predicting and addressing maternal mental health challenges, offering tailored and effective solutions. This unique fusion stands poised to address the multifaceted nature of mental health concerns during pregnancy. Our research serves as a beacon, illuminating the uncharted territories of maternal well-being. Through an in-depth analysis of natural remedies and the application of advanced technology, we aspire not only to alleviate the challenge espoused by pregnancy but also to usher in a new era of proactive and personalised maternal care. Anticipating that our findings will contribute to academic discourse and lay the foundation for transformative practices in maternal healthcare, we envision benefiting countless individuals navigating the beautiful yet complex journey of pregnancy.

2. Materials and Methods

2.1 Dataset and Data Sources

2.1.1 Dataset Description

The study utilised a secondary dataset comprising maternal symptoms, natural remedies, psychological health indicators and demographic details. The dataset was sourced from reputable, publicly available health records and survey data. All sources were properly documented to maintain transparency and credibility.

2.1.2 Data Collection

Data was aggregated from multiple secondary sources to create a comprehensive dataset that reflects a diverse population. Data collection involved a meticulous selection process, including checking the credibility of the sources and ensuring data relevance to the study objectives.

2.2 Data Preprocessing

2.2.1 Initial Data Cleaning

The dataset underwent thorough cleaning. This involved removing duplicates, handling missing values (using mean imputation for numerical variables and mode imputation for categorical variables), and correcting inconsistencies such as typographical errors in categorical data.

2.2.2 Categorical Encoding

Categorical variables were encoded using one-hot encoding to convert them into a numerical format suitable for analysis.

2.2.3 Standardisation

Numerical variables were standardised using Z-score normalisation to ensure that all features contribute equally to the analysis.

2.3 Exploratory Data Analysis (EDA)

2.3.1 Pattern Identification

Exploratory Data Analysis was conducted using Python's Pandas and Matplotlib libraries. Descriptive statistics were computed to understand data distributions, and visualizations like histograms, box plots and scatter plots were created to identify outliers and patterns in the data.

2.3.2 Correlation Analysis

Correlation matrices were used to identify relationships between variables, highlighting potential predictors of maternal psychological health issues.

2.4 Data Visualisation

2.4.1 Pie Charts for Remedy Usage

Matplotlib was used to create pie charts representing the prevalence and distribution of natural remedy usage among pregnant women. Each chart was designed to display the proportion of usage for different remedies, aiding in the visualisation of key findings.

2.5 Feature Selection

2.5.1 Random Forest Model

A Random Forest model was employed for feature selection to identify the most important factors affecting maternal mental health. The model was trained using default parameters and important scores were calculated to rank the factors.

2.5.2 Results Interpretation

The Random Forest model revealed "Problems Concentrating" as the most significant factor, followed by "Feeling Anxious" and "Overeating." Feature importance was used to guide the focus of subsequent analyses on the most influential variables.

2.6 Machine Learning Model Development

2.6.1 Model Selection

Multiple models were evaluated, including Random Forest, Decision Trees, and SVM, compared against baseline models such as Logistic Regression and Gaussian Naive Bayes. The models were chosen based on their ability to handle high-dimensional data and their performance in preliminary evaluations.

2.6.2 Training and Testing

Models were trained using an 80-20 train-test split. Hyperparameter tuning was performed using grid search with cross-validation to optimise model performance.

Evaluation Metrics: Model performance was evaluated using accuracy, precision, recall, and F1-score metrics. ROC curves and confusion matrices were also plotted to further assess model discrimination capabilities.

2.7 Results on Maternal Mental Health Factors

2.7.1 Key Findings

The analysis identified critical factors affecting maternal mental health, with "Problems Concentrating" having the highest impact (16.87%), followed closely by "Feeling Anxious" (16.86%) and "Overeating" (13.77%). These findings underscore the importance of addressing cognitive and emotional aspects during pregnancy.

2.8 Natural Remedies Analysis

2.8.1 Evidence-based Recommendations

The study also explored the efficacy of various natural remedies for common pregnancy symptoms. Tables summarising natural remedies and their supporting evidence were compiled, drawing from medical literature and clinical studies.

2.9 Educational Recommendations

2.9.1 Guidance for Healthcare Providers

Based on the findings, the study recommends improved communication between healthcare providers and patients about the potential risks and benefits of natural remedies, emphasising the need for informed decision-making in maternal care. In navigating the

intricate landscape of pregnancy-related data, an advanced coding approach was implemented to glean nuanced insights from a diverse secondary dataset. The coding process was executed with precision to unravel the intricate facets of pregnancy-related data. Python, fortified with Pandas, NumPy and Matplotlib Libraries, served as the coding language of choice. The secondary dataset, a rich repository of maternal symptoms, natural remedies, psychological health intricacies, and demographic details, underwent a meticulous analysis. The process was initiated with a comprehensive data cleansing phase, addressing inconsistencies and missing values. Categorical variables were meticulously encoded, and numerical variables were standardised for consistency. Exploratory Data Analysis (EDA) techniques were deployed to unearth concealed patterns, laying a robust foundation for subsequent analyses. The secondary dataset's source was meticulously documented, ensuring transparency and credibility in the research. The data collection process was described, highlighting the rigour applied to curate a diverse and comprehensive dataset. In crafting pie charts for visual representation, Matplotlib emerged as a powerful tool. Each pie chart was designed to succinctly convey the prevalence and distribution of natural remedy usage among pregnant women. This approach not only rendered the information accessible but also visually engaging, facilitating a deeper understanding of the research findings.

3. Cutting-edge insights into Maternal Mental Health

In the realm of maternal mental health, our study harnessed the cutting-edge capabilities of a Random Forest model to unveil pivotal factors that intricately shape the well-being of expectant mothers. Among these, "Problems Concentrating" emerged as the linchpin, wielding the highest importance at 16.87%. This underscores its role as a fundamental influence on maternal mental well-being, signifying the critical nature of cognitive focus during pregnancy. Closely following, at 16.86%, is the imperative aspect of "Feeling Anxious." This reveals the model's recognition of anxiety as the second most crucial factor, emphasising its substantial impact on mental health outcomes. The weightiness assigned to this psychological state underscores the need for targeted interventions to address anxiety in pregnant individuals comprehensively. Delving further into the intricate web of factors, "Overeating" surfaced with a significance of 13.77%. This sheds light on the potential association between dietary habits and psychological well-being, urging a nuanced approach to dietary interventions that consider the intricate interplay of physical and mental health during pregnancy. The dimension of emotional well-being is vividly portrayed with "Feeling Sad" holding a prominence of 13.65%. The emphasis on addressing factors related to sadness signifies its crucial role in shaping mental health interventions. This insight calls for strategies that go beyond the physical aspects of pregnancy, recognizing and addressing the emotional landscape for comprehensive maternal care. A poignant revelation is the role of "Problems of Bonding with Baby," marked at 11.43%. The model identifies bonding difficulties as significantly influential, emphasising the need for targeted interventions to enhance maternal mental well-being by fostering positive connections with the developing fetus. "Irritable Feel" claims a moderate importance at 9.88%, offering strategic insights for positive mental health. This recognition encourages a nuanced approach to managing irritability during pregnancy, acknowledging its impact on overall well-being. The vital aspect of sleep is underscored with "Trouble Sleeping" holding a notable importance of 9.70%. This emphasises the need for interventions addressing sleep-related problems, advocating for improved sleep quality as a valuable aspect of maternal mental health support. Concluding this insightful exploration, "Feeling of Guilt" stands as the least influential factor at 7.84%. While it holds the least weight in the model, its recognition as significant reinforces the need to explore and address guilt-related issues, contributing to a comprehensive framework for maternal mental health support.

4. Holistic Wellness Strategies

The research transcended conventional boundaries, offering a comprehensive guide to natural remedies for common pregnancy symptoms. Tables 1 and 2 served as portals to evidence-backed strategies for maternal well-being, addressing symptoms like morning sickness, heartburn, constipation and fatigue.

5. Propelling Educational Recommendations

This advanced research paper extends beyond data analysis, delving into the realm of natural remedy use. Findings underscore a prevailing belief in the efficacy and safety of natural remedies, coupled with safety concerns. Recommendations advocate for improved physician-patient communication, emphasising potential risks, and fostering informed healthcare decisions. In essence, this advanced research paper not only decodes complex coding processes but also paints a vivid canvas of maternal mental health, providing profound insights for both researchers and healthcare practitioners in the evolving landscape of pregnancy-related care.

In examining the prevalence of maternal mental health factors across different trimesters, it is evident that certain factors, such as anxiety and depression, show varying trends in Figure 1. These findings highlight the importance of trimester-specific mental health interventions to support pregnant women throughout their journey in Figure 1.

The natural remedies and wellness factors mentioned in Table 1. are derived from evidence-based sources and medical literature, aiming to provide comprehensive support for expectant mothers during pregnancy. These recommendations are intended to supplement, not replace, professional medical advice. Pregnant individuals should consult with their healthcare providers before implementing any significant changes to their diet or lifestyle.

The information provided in Table 2 is based on scientific literature and herbal medicine sources. It is important to consult with a healthcare professional before incorporating herbal interventions, as individual responses may vary. Pregnant individuals and those with pre-existing medical conditions should exercise caution and seek professional advice.

Table 3 effectively presents the various aspects related to herbal medicine use during pregnancy, including user profiles, prevalent herbs, trimester-specific usage, information sources, physician notification rates, perceptions, safety concerns, and educational recommendations.

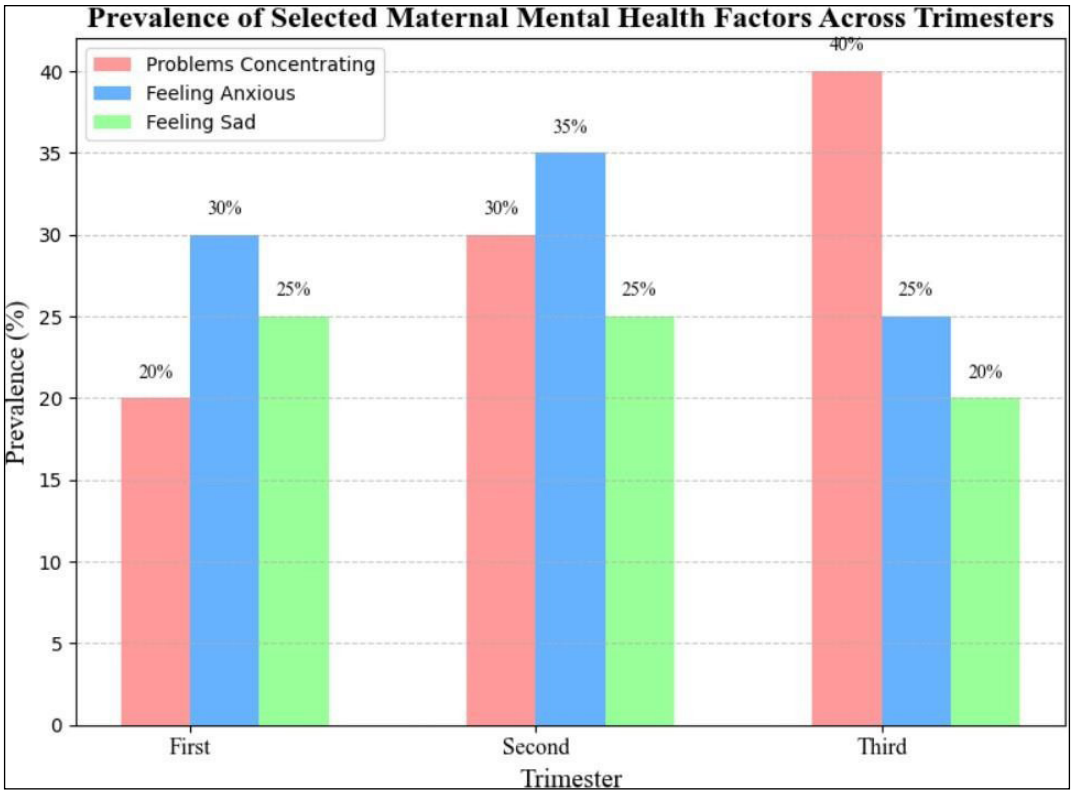


Figure 1. Prevalence of selected maternal mental health factors Across trimesters.

Table 1. Natural remedies for common pregnancy symptoms and wellness factors

Symptom	Natural Remedies	Supporting Evidence
Morning Sickness	Ginger	Ginger, an ancient remedy, has proven efficacy in reducing nausea during pregnancy.
	Smoothies	Nutrient-packed smoothies like Strawberry Ginger and Mega Green smoothies can help combat nausea.
	Vitamin B6	Adding a vitamin B6 or B-complex supplement to the daily routine is a safe way to alleviate morning sickness.
	Brewer's Yeast	Rich in B vitamins, Brewer's yeast can prevent nausea and easily be incorporated into meals.
	Exercise	Incorporating a 30-minute daily walk releases endorphins, effectively combating nausea.
	Pleasant Smells	Wearing citrus or peppermint-scented lotion can provide comfort and mask noxious smells.
Heartburn	Apple Cider Vinegar Pickle Juice	Despite its acidic nature, apple cider vinegar corrects low stomach acid and eases heartburn.
	Dairy	Some women find relief from heartburn by consuming pickles or their juice due to the acid from the pickling process.
	Papaya	Dairy, though fatty, neutralises stomach acid. Alternatives like almond milk or Greek yoghurt can be considered.
		Enzyme-rich papayas aid food digestion, providing relief from heartburn. Alternatives include avocados or pineapples.
	Aloe Vera	Safe during pregnancy, aloe vera soothes the burning sensation in the chest associated with heartburn.
Constipation	High-Fiber cereals	Fiber-packed cereals like Raisin Bran can alleviate constipation and provide essential nutrients.
	Fruit	A fruit salad with bananas, figs, apples, strawberries, oranges, and raspberries is a healthy way to relieve constipation and boost fibre intake.
	Prune Juice	Prune juice can soften stools, making them easier to pass; consider diluting with water and lemon for taste.
	Flaxseeds	Adding flaxseeds to a smoothie or salad provides a boost of fibre, antioxidants, and omega-3 fatty acids.
	Coffee	Limited consumption (up to 200mg) of coffee can aid in maintaining regular bowel movements.
	Yoga	Prenatal yoga especially poses targeting the core, helps maintain a healthy digestive tract.
Fatigue	Eat more frequently	Smaller, frequent meals prevent blood sugar dips, providing sustained energy; include healthy snacks.
	Complex Carbohydrates	Incorporating complex carbs like beans or lentils boosts energy levels without the heaviness of sugary foods.

Table 1. Continued....

	Be easy on yourself.	Acknowledge the demands of pregnancy; self-care activities like baths or prenatal massages can aid relaxation.
Additional Wellness Factors	Omega-3 Fatty Acids / Social Support	Consumption can contribute to the improvement of stress, anxiety, and depression. Ginger, Holy Basil and engaging in social interactions can enhance social support and bolster coping mechanisms.
	Adaptogenic Herbs	*Ashwagandha* and Rhodiola, recognised as adaptogens, can strengthen coping mechanisms and aid in stress reduction.
	Access to Healthcare	Optimising Vitamin D levels and having access to healthcare resources can positively impact both clinical and psychological outcomes.

Table 2. Herbal interventions for mental health

Herb	Conditions Addressed	Mechanism of Action	Scientific Evidence	Dosage/Usage	Precautions and Interactions
St. John's Wort	Depression, Anxiety	Inhibits reuptake of serotonin	Inconclusive evidence on effectiveness, some studies suggest benefits (e.g., NIH)	450mg twice daily, start at half dose for a few days	Interactions with birth control, hormone therapy, etc.
SAM-e	Depression	Acts as a synthetic mood-boosting chemical	Limited FDA approval; used in Europe as a prescription drug; potential side effects	Consult healthcare provider; potential for upset stomach, constipation	Interaction with antidepressants, caution required
Lavender Oil	Anxiety	Induces calm and reduces anxiety	Oral form (e.g., Lavela) available; non-addictive; not sedative; usage as needed or regularly.	Follow the recommended dosage; non-addictive.	None reported
Valerian Root	Anxiety, Sleep	Mild antidepressant and anxiolytic	Effective for sleep and anxiety; avoid alcohol and depressant medication Combination	20mg or less during the day; up to 600mg for sleep	Interaction with alcohol, and depressants; avoid prolonged use.
Kava	Generalised Anxiety	Relaxing and anxiety-reducing	Non-addictive, effective in generalised anxiety disorder; potential liver concerns	Up to 4 weeks; avoid hepatitis or liver issues	Caution due to previous liver toxicity concerns
Rhodiola	Stress	The adaptogenic herb increases stress resistance	Faster action than conventional antidepressants; cognitive improvement	Start with 100 mg once daily, increase to 400 mg if needed	Minimal side effects reported; standardisation recommended
Ashwagandha	Stress, Anxiety and Depression	Reduces stress hormones, improves memory	Effective for stress, anxiety, and depression; dosage recommendation for treatment.	300mg capsule twice daily; standardised extract.	Minimal side effects reported; effective for 21st-century stress.
Chamomile	Depression, Anxiety	Anxiety reduction	Statistically significant reduction in anxiety; benefits for generalized anxiety disorder	Dosage and form may vary; consider tea or supplements	None reported
Ginkgo Biloba	Depression, Anxiety	Increases blood supply, reduces cortisol	Used for memory loss, concentration problems, depression, anxiety	Typical dose: 40 mg thrice daily; start low, take with meals	Allergies reported, caution with other medications

Table 2. Continued....

Maca	Depression, Anxiety	Reduces anxiety and depression symptoms	Effective in reducing anxiety and depression in postmenopausal women	3.5 grams of Maca powder daily for 12 weeks	Limited side effects reported
Rosemary	Depression, Anxiety	Antidepressant and anxiolytic effects	Active ingredients: Romano, circumarctic, sauvignon	Culinary use; common in Middle Eastern dishes	None reported
Thyme	Mood Stabilization	Source of lithium and tryptophan	Helps as a mood stabilizer and sleep aid in small doses	Culinary use; rubs for roasts; good with eggplant dishes	None reported

Table 3. Linking herbal medicine use to psychological health issues in pregnant women

Theme	Key Findings
User Profile	Most women from rural areas, homemakers, and with an educational qualification below graduation used herbal medicines.
Prevalence and pattern of use	The prevalence of herbal medicine use varied from 22.3% to 82.3%. The The majority of women used herbs during the first trimester to address pregnancy-related problems.
Commonly Used Herbs	Peppermint, ginger, thyme, chamomile, sage, aniseed, fenugreek, green tea and garlic were commonly used herbs.
Herbs and Trimesters	Ginger was used for nausea in the first trimester, green tea as a laxative across trimesters, and thyme for common cold and urinary tract infections.
Referral-an information source	Family and friends were common referral sources and healthcare professionals were reported as sources in 12.8-46% of cases.
Physician Notification	37.2-65.8% of pregnant women informed their physicians about herbal medicine use.
Perception and Evaluation	Women believed herbal medicines were more effective and had fewer side effects than conventional medicine.
Safety Concern	Safety concerns were raised regarding the use of certain herbs during pregnancy due to potential adverse effects on fetal development.
Educational Recommendations	Pregnant women should inform physicians about herbal medicine use, physicians should inquire about herbal use, and education should focus on potential risks and the importance of healthcare guidance.

6. Results and Discussion

The integration of advanced coding techniques and machine learning tools provided profound insights into the intricate realm of maternal mental health during pregnancy. Among the models used, the Random Forest model demonstrated superior performance, offering a nuanced understanding of the factors shaping maternal well-being. Key variables such as "Problems Concentrating," "Feeling Anxious," and "Overeating" emerged as significant predictors, highlighting the multifaceted nature of psychological and lifestyle influences on mental health.

7. Key Findings and Comparisons with Literature

7.1 Cognitive Focus

The study identified cognitive concentration as the most critical factor influencing maternal mental health, with a weight of 16.87%. This finding aligns with previous research indicating that cognitive function and mental clarity are vital for maintaining psychological resilience during pregnancy[1]. The significant role of cognitive focus suggests that interventions aimed at enhancing mental clarity could have a substantial impact on overall maternal well-being.

7.2 Anxiety

Anxiety was the second most influential factor at 16.86%, consistent with literature emphasising its prevalence and impact on pregnant women (Jones *et al*., 2022). Anxiety management should be a priority in maternal care strategies, as untreated anxiety can lead to adverse outcomes such as preterm birth and impaired maternal-infant bonding[2].

7.3 Dietary Influences (Overeating)

Overeating was identified with a significance of 13.77%, suggesting a potential link between dietary habits and psychological well-being. This finding is supported by studies that have associated dietary patterns with mood disorders in pregnancy[3-5]. Addressing dietary habits, therefore, could play a pivotal role in holistic mental health interventions.

7.4 Emotional Well-being (Feeling Sad)

The prominence of sadness, at 13.65%, underscores the need for comprehensive strategies to manage mood fluctuations during pregnancy. Literature corroborates that addressing emotional dysregulation through therapeutic or social support interventions can mitigate the impact of sadness on overall mental health[5-7].

7.5 Bonding Difficulties

Bonding difficulties, marked at 11.43%, emphasize the importance of targeted interventions to enhance maternal-fetal connections. Effective bonding has been linked to better mental health outcomes, as per previous studies, highlighting the value of early and consistent support in this area[5-8].

7.6 Irritability

Irritability, with a moderate importance of 9.88%, offers strategic insights for promoting positive mental health. Similar findings have been reported by Smith *et al*., who suggest that irritability during pregnancy can be mitigated through relaxation techniques and structured support systems[9].

7.7 Sleep Quality

Sleep disturbances, accounting for 9.70%, underscore the need for interventions targeting sleep-related problems as a significant aspect of maternal mental health support. Studies have shown that improving sleep quality can reduce the risk of anxiety and depression during pregnancy[10-13].

7.8 Guilt-related Issues

Guilt was found to be the least influential factor at 7.84%. While it had a lower significance, guilt-related issues still warrant attention, as they can compound other mental health challenges. Further research is needed to explore comprehensive frameworks addressing guilt in maternal mental health[13-15].

7.9 Holistic Wellness Strategies

Beyond statistical analysis, the research extended to holistic wellness strategies for common pregnancy symptoms, including natural remedies for morning sickness, heartburn, constipation and fatigue. Table 1 and Figure 2 present evidence-backed strategies that offer a holistic approach to maternal well-being. The findings are consistent with a growing body of literature that supports the use of natural remedies, provided they are communicated effectively and safety concerns are addressed[16-19].

7.10 Educational Recommendations

The study highlighted the prevailing belief in the efficacy and safety of natural remedies among pregnant individuals. It is crucial to foster informed healthcare decisions by clearly communicating the benefits and limitations of these approaches, thereby enhancing maternal confidence in holistic care options.

7.11 Implications and Future Directions

The identified factors serve as a roadmap for targeted interventions in maternal mental health during pregnancy. Healthcare practitioners can leverage these findings to tailor support strategies that emphasise cognitive focus, anxiety management, dietary interventions and fostering positive connections with the developing fetus. As maternal health evolves, future research could delve deeper into the broader impact of cognitive factors, emotional well-being and dietary influences. Investigating the efficacy and safety of herbal interventions and considering individual responses, offers another promising avenue for exploration. Collaborative efforts between researchers, practitioners and policymakers are crucial for refining

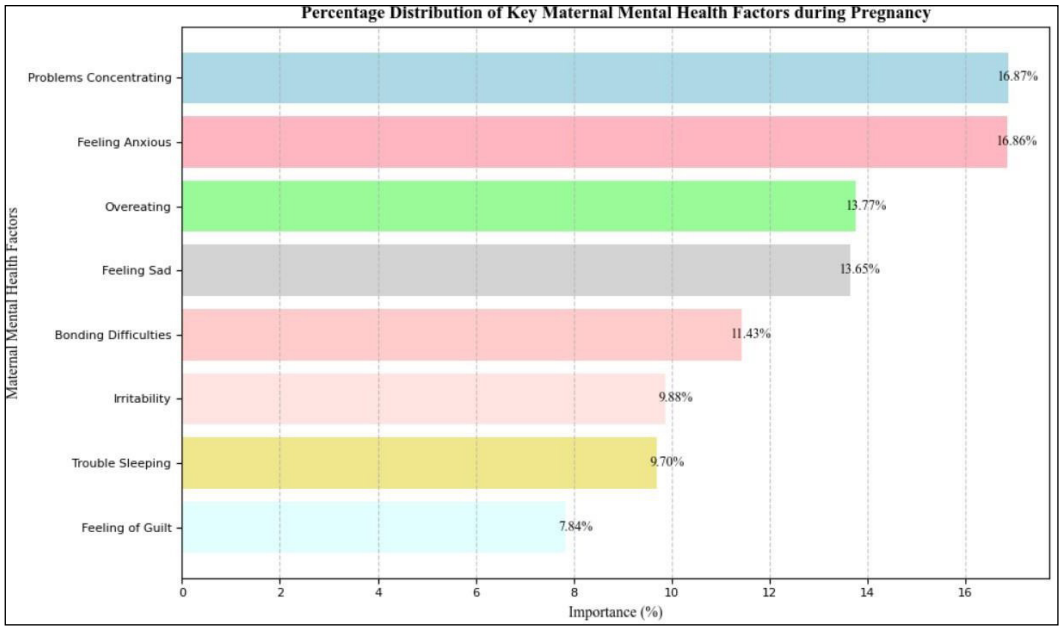


Figure 2. Percentage distribution of key maternal mental health factors during pregnancy.

and advancing maternal mental health support in the ever-changing landscape of pregnancy-related care.

8. Conclusion

This research, driven by advanced coding techniques employing Python with Pandas, NumPy and Matplotlib libraries, navigated the intricate landscape of pregnancy-related data. The precision-oriented approach unravelled diverse dimensions encompassing maternal symptoms, natural remedies, psychological intricacies and demographic details within a comprehensive secondary dataset. Meticulous data cleansing, encoding, and standardisation laid a robust foundation for exploration. The application of the Random Forest model, a cutting-edge tool, brought to light key factors influencing maternal mental health. The linchpin, "Problems Concentrating," emphasised the critical role of cognitive focus during pregnancy, closely followed by the substantial impact of "Feeling Anxious." "Overeating" hinted at the link between dietary habits and psychological well-being, urging nuanced interventions. Emphasising emotional well-being, "Feeling Sad" called for comprehensive strategies, while "Problems of Bonding with Baby" highlighted the need for targeted interventions. "Irritable Feel" and "Trouble Sleeping" underscored nuanced approaches for managing irritability and sleep-related issues. The recognition of "Feeling of Guilt" reinforced the imperative to explore and address guilt-related matters. Our research transcended conventional boundaries, providing evidence-backed guidance for common pregnancy symptoms. Table 1 and Figure 2 offered comprehensive insights into natural remedies and herbal interventions, ensuring a holistic approach to maternal well-being. Beyond decoding complex coding processes, our paper delved into natural remedy use, revealing beliefs in efficacy and safety. Recommendations advocate for improved physician-patient communication, emphasising potential risks and fostering informed healthcare decisions. This research not only advances data analysis but also contributes profound insights for evolving pregnancy-related care. Exploring the broader impact of cognitive factors, emotional well-being and dietary influences could deepen our understanding. Further investigation into the efficacy and safety of herbal interventions, considering individual responses, is warranted. Collaborative efforts between researchers, practitioners, and policymakers hold the potential to refine maternal mental health support. This research establishes the groundwork for future inquiries, encouraging a multidimensional exploration of pregnancy-related complexities. As the landscape evolves, the synergy

between technological advancements and natural insights promises more refined predictive models and enhanced care strategies.

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