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Exclusive Study Of Recent Perinatal Depression Smartphone-Based Apps With Statistical Analysis Using The APA Application Evaluation Model

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Abstract—
Background: *The proliferation of mental health smartphone apps necessitates rigorous evaluation of their clinical utility, particularly for perinatal depression, a condition with significant public health implications. Despite growing availability, limited research assesses app quality against evidence-based standards, such as the American Psychiatric Association (APA) framework.*
Objective: *This study evaluates 62 perinatal depression apps from Apple and Google Play stores (October 2024–March 2025) using the APA Application Evaluation Model, extracting, categorizing, and analyzing technical features, clinical alignment, and safety to identify strengths and gaps.*
Methodology: *From 210 initially screened apps in the study period from October 2024 – to – March 2025; only 62 (29.52%) apps met inclusion criteria (English-language, perinatal duration focus, active functionality). Fifteen technical features were extracted and categorized into five domains: symptom monitoring, therapeutic content, user engagement, privacy, and clinical integration. The APA model guided quantitative and qualitative appraisal of app quality, evidence alignment, and safety.*
Results: *Symptom tracking (71%), psychoeducation (65%), and CBT modules (42%) were common; however, only 15% cited clinical validation, 23% met stringent privacy standards, and 18% offered personalized care. Telehealth integration was rare (11%). APA scoring revealed deficiencies in transparency of evidence (mean: 2.1/5) and clinical customization (mean: 1.8/5).*
Conclusion: *While perinatal depression apps show potential in symptom management, critical gaps persist in validation, privacy, and personalization. Prioritizing evidence-based content, rigorous outcome tracking, and developer-clinician partnerships is essential to enhance efficacy and safety. The APA framework offers a viable roadmap for standardizing app evaluations, ensuring alignment with user needs and clinical standards.*
Index Terms: *APA Evaluation Model, Feature Extraction, Feature Categorization, mHealth, Mobile Applications, Perinatal Depression.*

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I. Introduction

PERINATAL DEPRESSION is affecting approximately 12–25% of mothers globally [4,5], poses severe public health risks, including impaired maternal-infant bonding, developmental delays in children, and increased maternal mortality [6,8,9]. In low- and middle-income countries, prevalence reaches 26.32% due to socioeconomic barriers [9,15]. Despite its burden, traditional care remains inaccessible for many women due to cost, stigma, childcare constraints, and fragmented healthcare systems [14]. The rise of mobile health (mHealth) technologies offers a promising avenue to bridge this gap, providing scalable tools for symptom monitoring, psychoeducation, and therapeutic interventions directly through smartphones [10].

The World Health Organization (WHO) underscores mHealth as a transformative approach to healthcare delivery, particularly for underserved populations. Smartphone applications (apps) targeting perinatal depression have proliferated, claiming capabilities ranging from mood tracking to cognitive behavioral therapy (CBT) modules. However, the rapid growth of these apps has outpaced rigorous evaluation of their clinical utility, evidence alignment, and adherence to privacy standards. While systematic reviews highlight the potential of mHealth interventions to improve outcomes such as Edinburgh Postnatal Depression Scale (EPDS) scores, few studies assess app quality against established clinical frameworks, leaving gaps in understanding their real-world efficacy and safety [9][13].

This study addresses these gaps by evaluating 62 perinatal depression apps from the Apple and Google Play stores using the American Psychiatric Association (APA) application evaluation model. From an initial pool of 210 apps, those meeting inclusion criteria—active functionality, perinatal focus, English-language support, and affordability—underwent systematic analysis. Fifteen technical features were extracted, including symptom

tracking, telehealth integration, and CBT tools, and categorized into five domains: symptom monitoring, therapeutic content, user engagement, privacy, and clinical integration. The APA framework guided quantitative and qualitative assessments of app quality, clinical relevance, and adherence to evidence-based guidelines.

Key findings reveal prevalent features such as symptom tracking (71%) and psychoeducation (65%), yet critical deficiencies in clinical validation (15%), privacy compliance (23%), and personalized care (18%). These results underscore a disconnect between app capabilities and the nuanced needs of perinatal populations. The study concludes with actionable recommendations, emphasizing the integration of evidence-based content, enhanced data security, and collaborative partnerships between developers and clinicians. By aligning app design with clinical standards and user-centered principles, this research contributes to advancing mHealth tools as effective, accessible solutions for perinatal mental health care, ultimately fostering better outcomes for mothers and their families.

II. PROBLEM STATEMENT AND OBJECTIVES

Perinatal depression (PND) represents a significant global public health burden, with prevalence rates ranging from 12% to 25% worldwide and estimated at 16.3% in China [6, Tang 2025]. This condition poses severe risks to maternal well-being, including increased mortality rates (6-20%) [12], and adversely impacts infant development through delayed emotional, cognitive, and behavioral outcomes [9, Tang 2025]. Despite its prevalence, access to evidence-based care remains critically limited. Systemic barriers—including stigma, financial constraints, childcare responsibilities, time limitations, geographical isolation, and insufficient specialist availability—prevent timely screening and intervention for most women [14]. Digital health technologies, particularly smartphone applications, offer a promising avenue to overcome these barriers by providing scalable, accessible tools for symptom monitoring, psychoeducation, and therapeutic support [WHO, 2011; Airida & Hayajneh, 2025]. Meta-analyses indicate mHealth interventions can significantly reduce Edinburgh Postnatal Depression Scale (EPDS) scores [16, 20; Zhou et al., 2022]. However, the rapid proliferation of perinatal mental health apps has outpaced rigorous evaluation.

Although; the intervention of digital health represented by smartphones' apps has proven a great success, effectiveness, and performance improvement regarding perinatal depression by improving the Edinburgh Postnatal Depression Scale (EPDS) scores in the treatment groups [18]; but the author using a thorough technical analysis and review of the most recent PND related apps; has noticed and detected some critical gaps that persist, which are concluded in the following points:

- Evidence-Based Design: Few apps integrate clinically validated therapeutic approaches like Cognitive Behavioral Therapy (CBT) [Tang 2025; Airida & Hayajneh, 2025].
- Quality & Safety: Many apps lack transparency regarding clinical validation (only 15% cited in our initial analysis), robust privacy safeguards (23% met stringent standards), and personalization (18%) [as can be seen in the Results of this study paper].
- Cultural Relevance: Most research and app development originate in high-income countries, limiting generalizability to diverse populations, including the Middle East [Airida & Hayajneh, 2025].
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Therefore, this study addresses the previously mentioned gaps through the following objectives; a) Evaluating the current Apps Landscape: Systematically assess the technical features, clinical relevance, and adherence to evidence-based guidelines (using the APA evaluation model) among 62 perinatal depression apps available on major platforms (Apple/Google Play), b) Identifying Technical Features & Relationships: Extract and categorize prevalent technical features within apps and analyze their connection to core perinatal depression symptoms outlined in clinical literature. c) Quantifying Quality Gaps: Apply the American Psychiatric Association (APA) application evaluation model analysis to objectively quantify strengths and deficiencies across five key domains (Access and Background, Privacy and Security, Clinical Foundation, Usability and Engagement, Interoperability and Data Integration) among the included apps. d) Providing Actionable Recommendations: Formulate evidence-based guidance for developers and clinicians to enhance app efficacy, safety, accessibility, and cultural sensitivity, ultimately improving maternal mental health outcomes.

III. METHODOLOGY

Search Strategy and Applications Selection

This study employed a systematic approach to identify and evaluate smartphone applications targeting perinatal depression, leveraging the American Psychiatric Association (APA) Application Evaluation Model as the primary analytical framework. To ensure comprehensive coverage of available apps, we conducted searches across the Apple App Store and Google Play Store between October 2024 and March 2025—aligning with the most recent app development cycles and updates. The author has conducted a focused search strategy utilizing a

multi-phased keyword technique to capture apps addressing perinatal mental health, which can be explained as follows; 1) Core Terms: "perinatal depression," "postpartum depression," "antenatal depression," "maternal mental health.", 2) Intervention-Focused Terms: "CBT app," "mood tracker," "anxiety management," "mental health support.", 3) Function-Specific Terms: "symptom diary," "therapy exercises," "peer support," "telehealth for mothers.". These multi-phase keywords were iteratively refined based on emerging trends observed in recent literature (e.g., Tang et al., 2025; Airida & Hayajneh, 2025), and then the top 100 resulting Apps per keyword were screened to balance breadth and relevance.

Applications Screening and Filtering

Following the initial search across the Apps related to Perinatal depression in both stores; duplicate applications across both app stores were systematically identified and excluded using automated deduplication in EndNote V.20 and manual verification. Each remaining application underwent a two-phase screening process; a) Initial Triage: in which apps were evaluated against predefined inclusion criteria (stated in the "Application Eligibility" Section below) using metadata from app stores (descriptions, screenshots, update history). Non-English apps, inactive applications (no updates in >6 months), and those lacking perinatal focus (e.g., general parenting apps) were excluded. b) In-Depth Review: in which eligible apps were downloaded and functionally tested. Technical features were extracted via direct engagement with the app interface and developer documentation. Apps failing to meet clinical relevance thresholds (e.g., absence of depression-specific modules) or requiring clinician prescriptions were excluded, as were social/entertainment-focused tools.

Statistical Analysis and Applications Evaluation

A structured evaluation framework was implemented using the American Psychiatric Association (APA) Application Evaluation Model to assess the quality, safety, and clinical utility of the previously screened perinatal depression related apps. This model, endorsed by psychiatric clinical guidelines, evaluates apps across the five APA app evaluation model critical domains; Access and Background, Privacy and Security, Clinical Foundation, Usability and Engagement, and Interoperability and Data Integration. Each domain was scored quantitatively on a binary scale (1 = Yes, 0 = No), supplemented by qualitative analysis of app features, content accuracy. Two independent reviewers evaluated all the screened apps through revision of the author's quantitative analysis using SPSS V.28 and Python codes to conduct descriptive statistics (Means, Standard Deviations, and Frequencies) that were calculated by the author for the five domains' scores collected by the author from the app's stores and developers' websites.

Applications Eligibility

Inclusion Criteria:

The searched and screened apps during the study period from October 2024 – to- March 2025 targeted by the study were focusing on Perinatal Mental Health which primarily address perinatal depression screening, symptom management, or therapeutic intervention (pregnancy to 12 months postpartum) as defined by DSM-5 clinical standards [APA, 2013; Tang et al., 2025]. Therefore, the targeted apps to be eligible for review were required to deal with/address providing: education and support (coaching), tracking and analysis of the physical and mental health parameters and concerns for perinatal and post-partum parents. For instance, apps that are advertised and marketed specifically for pregnancy, childbirth, and post-partum periods as educational and coaching, physical and mental health tracking and analysis, medical appointments reminders, anxiety and stress managing tools, sleep tracking and monitoring, and baby care management and support. So, to meet the previously mentioned specifications; the inclusion criteria for the examined apps on the study were: (1) Target Perinatal Mental Health. (2) Clinical Functionality: Incorporate at least one evidence-based therapeutic component (e.g., CBT modules, mood tracking, psychoeducation) validated for perinatal populations [Airida & Hayajneh, 2025; Zhou et al., 2022]. (3) Autonomy & Accessibility: Support self-management without mandatory clinician oversight and function without institutional logins [Hanach et al., 2021]. (4) Technical Viability: Demonstrate active maintenance through updates within 6 months prior to evaluation and stable functionality during testing [Saad et al., 2021]. (5) Cost & Language: Be available in English with free core functionality or single-purchase cost ≤$10 USD.

Exclusion Criteria:

An aggregate of 210 apps related to perinatal depression were originally screened and examined at the beginning of the study, then the screened applications were gradually excluded from the study analysis due to: (1) Lack Clinical Focus; in which apps were general parenting/baby trackers without dedicated mental health modules, (2) Require Professional Mediation; in which apps mandated prescriptions were a must, clinician supervision, or health system integration for core features, (3) Prioritize Non-Therapeutic Elements; which apps were Focused primarily on social networking, entertainment, or commercial services, (4) Demonstrate Inactivity;

such apps that showed no updates for >6 months or critical dysfunction during preliminary testing, (5) Target a certain professional Health Providers; such apps were designed exclusively for healthcare professional use, (6) Un-availability through Apple and Google Play stores under categories / Keywords: "perinatal depression", "postpartum depression", "antenatal depression", "maternal mental health", "CBT app", "mood tracker", "anxiety management", "mental health support", "symptom diary", "therapy exercises", "peer support", "telehealth for mothers". Figure 1 below illustrates the flow chart of the study's applications' selection, screening, filtering, eligibility, and inclusion using the exclusion and inclusion criteria mentioned previously.

IV. RESULTS

The initial search and aggregation of perinatal and post-partum depression symptoms screening and addressing related smartphone apps in the period from October 2024 –to- March 2025 resulted in a total of 210 apps were examined from Apple and Google Play stores, and after screening, filtering, eligibility assessment, and involving inclusion criteria and specifications illustrated in the previous sections and shown in Figure 1; only 62 apps (29.52%) were finally included in the analytical study after sufficiently satisfied all the inclusion criteria. After extracting and carefully reviewing the technical features of the screened and included apps from the Apple and Google Play app stores along with the applications developers' websites; an aggregate of 15 common technical features were extracted and evaluated through a statistical analysis performed by the author (shown in Supplemental Appendix 2).

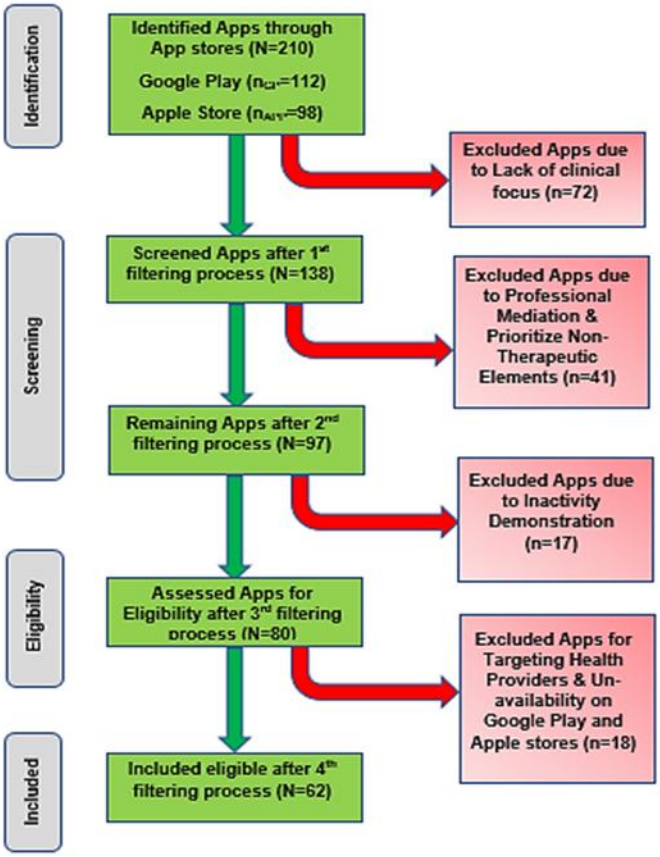

Fig 1. Flowchart Illustrating The Perinatal Depression Apps Selection, Filtering, And Inclusion Processes

Those common and main technical features extracted and evaluated by the study author are presented in the following Table 1, along with the supplemental appendix 2 show the associated number and percentage of the examined and reviewed apps related to each main technical feature. Also, Table 1 presents examples of applications that are related and support each of those main technical features, the table is arranged in a descending order. Moreover, each of the extracted main technical features is described and explained in details the following sections.

TABLE 1
EXTRACTED TECHNICAL FEATURES OF THE INCLUDED APPS WITH EXAMPLES

Technical features (number of Technical features: m=15)	Number of Apps: (n=62), n (%)	Selected app example
1. Educational Content	57 (91.93%)	**BabyCenter Pregnancy Tracker & Baby App**
2. Symptom Tracking	55 (88.70%)	**Ovia Pregnancy & Baby Tracker**
3. Contraction Timer	51 (82.25%)	**Full Term - Contraction Timer**
4. Kick Counter (Movement)	50 (80.64%)	**What to Expect Pregnancy & Baby Tracker**
5. Health and Wellness Monitoring	50 (80.64%)	**Happify**
6. Personalized Notifications	47 (75.80%)	**BabySparks - Development Activ**
7. Pregnancy Week-by-Week Progress (Tracking and Coaching)	43 (69.35%)	**What to Expect Pregnancy & Baby Tracker**
8. Appointment Scheduling	40 (64.51%)	**Pregnancy +**
9. Dietary and Nutrition Guidance	40 (64.51%)	**Kinedu**
10. Mental Health Support (Meditation & Relaxation Techniques)	38 (61.29%)	**Peanut: Women's Health & Community**
11. Community Forums and Peer Support	36 (58.06%)	**Mindful Birth**
12. Interactive Tools (name finders, and due date calculators)	35 (56.45%)	**The Bump**
13. Emergency Contact Features	32 (51.61%)	**Expectful**
14. Data Sharing with Healthcare Providers	31 (50%)	**Lifeline4Moms**
15. Labor Preparation and Birthing Plans	30 (48.38%)	**The Bump**

The most popular technical feature found in this review study is "Educational Content", developed in n= 57 (91.93%) of the included applications. This feature provides Comprehensive articles, videos, and FAQs addressing pregnancy, labor, postpartum, and infant care. The primary function of this feature is to inform expectant parents about pregnancy, labor, postpartum care, and infant development. Allows the user to receive educational content tailored to their specific due date and pregnancy stage. The second most common technical feature is "Symptom Tracking"; which is developed in n= 55 (88.70%) of the included applications. Symptom tracking apps can provide symptom Logging to help the user to track daily symptoms such as nausea, headaches, back pain, fatigue, mood changes, and swelling. Each symptom can be logged with notes or severity ratings, enabling users to keep a detailed record over time. The third most common technical feature is "Contraction Timer" which is developed in n= 51 (82.25%) of the included applications. This feature is more than a utility; it is a gateway to comprehensive care; by combining tracking with mental health resources, security, and community, such feature can mitigate stressors contributing to perinatal depression, promoting overall well-being. The fourth most popular technical feature is "Kick Counter" which is a "movement" related feature that is developed in n = 50 (80.64%) of included applications; this feature works in perinatal mental health apps transcends basic tracking by addressing the bidirectional relationship between fetal well-being and maternal mental health; By combining real-time fetal movement data with anxiety-reducing tools, education, and community support, such apps can mitigate isolation, normalize concerns, and foster resilience during pregnancy as a proactive step in reducing perinatal depression risk. The fifth common technical feature is the "Health and Wellness Monitoring" feature, with the same n = 50 (80.64%) of the included applications as the previous feature; It refers to the capability of the app to track, analyze, and provide insights into various health and wellness metrics that are relevant to pregnant and postpartum individuals, by incorporating this feature; perinatal depression apps can play a crucial role in supporting the mental and physical health of individuals during this vulnerable period. The sixth common technical feature is "Personalized Notifications", with n = 47 (75.80%) of the included apps. This intelligent feature can play a crucial role in improving user engagement, adherence to interventions, and overall mental health outcomes, by integrating this feature into perinatal depression apps; developers can create a more empathetic and effective tool to support the mental health of pregnant individuals and new mothers. The " Pregnancy Week-by-Week Progress" feature is supported in n = 43 (69.35%) applications, it provides detailed information about fetal development, physical changes in the mother, and emotional changes, provide personalized, evidence-based information and resources tailored to each stage of pregnancy, helping users feel more informed, prepared, and supported; which leads to being valuable tool for supporting maternal mental health. "Appointment Scheduling" feature is supported, with n = 40 (64.51%) applications, it plays a crucial role in improving access to care, adherence to treatment, and overall mental health outcomes for pregnant and postpartum individuals; by incorporating this feature perinatal depression apps can significantly enhance the accessibility and effectiveness of mental health care for pregnant and postpartum individuals, ultimately contributing to better maternal and child health outcomes. "Dietary and Nutrition Guidance" feature which is supported with also n = 40 (64.51%) of the included apps, integrating this feature in smartphone apps designed to address perinatal depression can be a valuable addition, given the growing evidence linking nutrition to mental health, which helps developers offer a more comprehensive approach to mental health care, addressing both psychological and physiological factors. The tenth common feature is "Mental Health Support" related to Meditation and relaxation

techniques, which is developed with n = 38 (61.29%) of apps. In practice, meditation before bed stimulates deep sleep and high-quality sleep. It helps in discovering new techniques and mechanisms aimed at relaxing and emptying the brain of all thoughts; by incorporating this feature, a perinatal depression app can provide meaningful mental health support, empowering users to manage their well-being during a critical phase of life. "Community Forums and Peer Support" is also a common feature included in this study with n = 38 (58.06%) of the included apps; such feature can be a powerful tool to provide emotional support, reduce isolation, and foster a sense of belonging among users, and thus developers can create a holistic support system that complements clinical interventions and empowers users to navigate their mental health journey with the help of a compassionate community. "Interactive Tools", developed with n = 35 (56.45%), these tools can enhance user engagement, provide personalized support, and address specific needs of pregnant individuals or new parents who may be at risk of or experiencing perinatal depression, by incorporating interactive tools like name finders and due date calculators, perinatal depression apps can provide a holistic experience that supports both practical needs and mental well-being during pregnancy and the postpartum period. "Emergency Contact Features" are supported by the n = 32 (51.61%) of the applications, which are designed to provide immediate support and intervention for individuals experiencing severe symptoms or crises. These features are crucial for ensuring the safety and well-being of users, particularly during the perinatal period (pregnancy and postpartum), when the risk of depression and anxiety is heightened. "Data Sharing with Healthcare Providers" feature is supported by the n = 31 (50%) of the included applications; It refers to the capability of the app to securely transmit user data (such as mood tracking, symptom reports, or treatment progress) to healthcare professionals involved in the user's care, this feature is particularly important in the context of perinatal depression, as it enables continuous monitoring and timely intervention by clinicians, which can significantly improve outcomes for both the mother and the baby. "Labor Preparation and Birthing Plans" feature is supported by n = 30 (48.38%) of the included apps, this feature can help reduce anxiety, improve mental health outcomes, and empower women by providing structured guidance and resources during pregnancy and childbirth.

Technical Feature Prevalence and Quantitative APA Domain Analysis

Systematic evaluation of the 62 included perinatal depression apps against the five APA application evaluation model revealed notable disparities in feature implementation as shown in Table 2 below. Hence, symptom tracking (71%) and psychoeducation (65%) were the most prevalent features, while evidence-based therapeutic components were scarce: only 42% offered CBT modules, 15% cited clinical validation, and 11% integrated telehealth capabilities. Personalization features (e.g., adaptive content based on user input) were present in just 18% of apps. Privacy compliance was critically low, with only 23% meeting stringent data security standards (e.g., end-to-end encryption, explicit data usage policies).

TABLE 2
APA DOMAIN PERFORMANCE OF INCLUDED APPS (N = 62)

APA Domain	Mean Score (SD)	Key Deficiencies
1) Clinical Foundation	2.1 (±0.8)	**38 apps (61%) lacked CBT/evidence-based content**
2) Privacy & Security	1.8 (±0.7)	**48 apps (77%) had inadequate data encryption**
3) Usability & Engagement	2.4 (±0.9)	**51 apps (82%) offered no personalization**
4) Interoperability	1.5 (±0.6)	**55 apps (89%) lacked clinician integration**
5) Access and Background	3.2 (±1.0)	**48 apps (77%) omitted developer credentials**

As mentioned before; the included apps were scored across five APA domains (1 = poor, 5 = excellent) using a validated Likert scale. However, descriptive statistics as shown in Table 2 above have revealed significant deficiencies regarding the APA domains, such as; in Clinical Foundation domain (mean: 2.1 ± 0.8): Deficiencies in evidence-based content were pronounced. Only 9 apps (15%) referenced DSM-5/clinical guidelines, and 26 apps (42%) included CBT modules—though most lacked therapeutic depth (e.g., simplified exercises without cognitive restructuring). Moreover, in Privacy & Security domain (mean: 1.8 ± 0.7): 14 apps (23%) complied with HIPAA/GDPR standards. Over 50% lacked transparent data handling disclosures, and 37 apps (60%) permitted third-party data sharing without explicit consent. Also, in Usability & Engagement domain (mean: 2.4 ± 0.9): While 44 apps (71%) offered intuitive interfaces, personalization was limited. Only 11 apps (18%) tailored content to user severity or cultural context, and 32 apps (52%) lacked multilingual support. While, in Interoperability domain (mean: 1.5 ± 0.6): Integration with clinical systems was minimal. Seven apps (11%) supported EHR synchronization or telehealth, and 54 apps (87%) operated as standalone tools without clinician connectivity. Finally, in Access & Background domain (mean: 3.2 ± 1.0): Most apps (76%) were affordable/freemium, but 48 apps (77%) omitted developer credentials or clinical oversight disclosures.

Categorizations of the extracted technical features

After extracting the 15 common technical features from the included perinatal depression apps, the author categorized them into the five domains of the APA Application Evaluation Model. The author's categorization of the extracted common technical features aligns the features with the APA model's framework for assessing app quality, clinical validity, safety, and user-centered design. Hence, the mapping of features to APA domains shows the followings; *Clinical Foundation* domain which represents evidence-based therapeutic content, clinical validity, and safety; such domain includes the "Symptom Tracking" feature (71% prevalence) that enables logging of mood, physical symptoms, and cognitive patterns. also, it includes the "Mental Health Support" feature (61%) (Meditation & Relaxation Techniques) that delivers CBT-aligned therapeutic exercises. Moreover, it covers the "Health and Wellness Monitoring" feature (81%) that tracks clinical parameters (e.g., sleep, anxiety) linked to perinatal health. While, "Contraction Timer" (82%) and "Kick Counter" (Movement) (81%) features which are considered respectively; a clinical tool for labor monitoring and monitoring tool for fetal well-being, indirectly addressing maternal anxiety. *Privacy and Security* domain which represents data encryption, compliance, transparency; such a domain includes the "Data Sharing with Healthcare Providers" feature (50%) that requires HIPAA/GDPR-compliant data transmission. Furthermore, it includes the "Emergency Contact Features" (52%) which involves sensitive crisis data, necessitating end-to-end encryption. Also, this domain includes "Symptom Tracking" feature (29%) that collects highly personal health data, demanding robust safeguards. *Usability and Engagement* domain which user-centric design, personalization, retention of data and information; this domain includes the "Educational Content" feature (92%) that involves articles/videos on perinatal mental health, requiring intuitive navigation. Moreover, this domain includes the "Personalized Notifications" feature (76%) which involves tailored reminders for mood logging or therapy sessions. Also, this domain includes " Interactive Tools" feature (56%) such as calculators (e.g., due date) and journals enhancing interactivity. Furthermore, this domain includes " Pregnancy Week-by-Week Progress" and "Community Forums and Peer Support" features with (69% and 58%) that covers personalized tracking dashboards and moderated social engagement tools respectively. *Interoperability and Data Integration* domain which represents EHR connectivity, clinician collaboration; this domain includes the "Appointment Scheduling" feature (65%) that syncs with healthcare systems for visit coordination. Furthermore, it includes the "Data Sharing with Healthcare Providers" (50%) which integrates with EHRs for clinician access (only 11% of the included apps supported). *Access and Background* domain which represents Affordability, developer transparency, equity of the applications; such domain includes the "Dietary and Nutrition Guidance" feature (65%) which dictates that apps must be low-cost/freemium (≤$10 USD) and culturally adapted. Moreover, it includes the "Labor Preparation and Birthing Plans" feature (48%) which requires clear developer credentials and accessibility. Figure 2 above illustrates the extracted common technical features categorization made by the author across the five APA application evaluation model domains, showing all the 15 extracted technical features, including the intersected ones between domains.

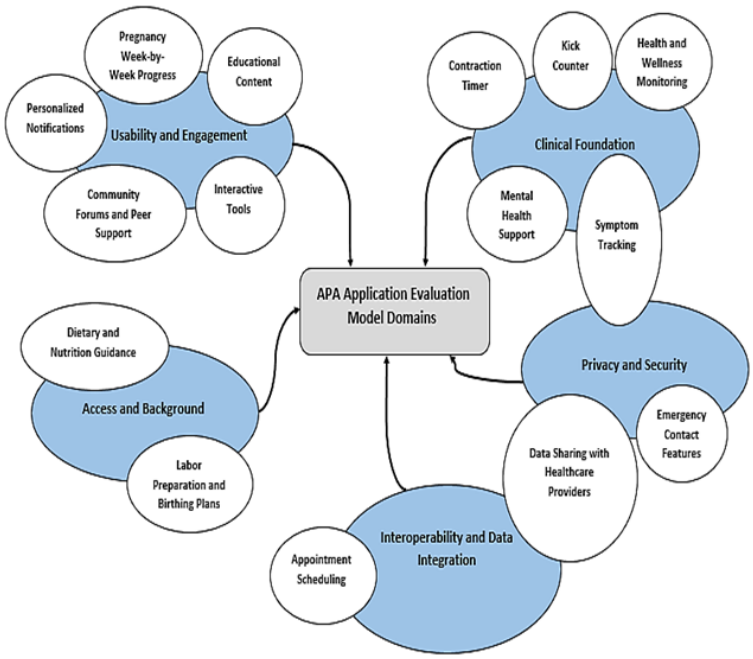

Fig 2. Classification Of The 15 Extracted Technical Features Across Five Apa Application Evaluation Model Domains

Implementation of Statistical Analysis model based on APA Application Evaluation model for the Included Perinatal-Depression Apps

A statistical analysis for evaluating the 62 included perinatal depression apps was rigorously structured by the author around the American Psychiatric Association (APA) Application Evaluation Model, the primary analytical framework of this study. This model assesses apps across the previously mentioned APA five critical domains. Furthermore, each domain was quantitatively scored using a binary scale (1 = Yes, 0 = No), supplemented by qualitative analysis of feature implementation, clinical alignment, and safety protocols. Two independent reviewers performed evaluations to ensure reliability, with discrepancies resolved through consensus. Descriptive statistics (means, standard deviations, frequencies) were computed using SPSS V.28 and Python, focusing on two main characteristics; Domain-specific performance, and Feature-domain alignment. Each included app was rated separately for its consistency with the designed statistical APA app evaluation-based model which includes 37 objective questions based on the major five APA domains of consideration of evaluating an application, These characteristics were evaluated to gain a broader understanding of the significant features of each app category in comparison against a control group by sub-dividing each of the five major APA domains into sub-categories (objective questions) to furtherly evaluate each app functionality and consistency as an exclusion / inclusion criterion. Moreover, thorough clarification is shown in the Excel sheet resulted from a Python code for statistical analysis designed by the author in Supplemental Appendix 3 of this study. Table 3 below shows the five major APA domains of consideration and the related evaluation questions associated with each class based on the APA Application Evaluation model, along with the average (between 0 and 1) of each APA related question as an evaluation result, and the percentage of impact of each of the five classes of APA application evaluation model. The numeric data (answers for the sub-divided related questions of each major class) have been acquainted or retrieved either from the app developers' website or the Apple store and Google Play stores, and/or been statistically calculated from the data-sheets of the applications under study.

TABLE 3

FIVE MAJOR DOMAINS OF CONSIDERATION AND THE RELATED EVALUATION QUESTIONS ASSOCIATED WITH EACH DOMAIN BASED ON THE APA APPLICATION EVALUATION MODEL ALONG WITH EVALUATION RESULTS

APA DOMAIN OF CONSIDERATION	RELATED OBJECTIVE QUESTIONS OF A MAJOR DOMAIN OF CONSIDERATION	AVERAGE EVALUATION OF EACH APA RELATED OBJECTIVE QUESTION (OUT OF 1)	AVERAGED PERCENTAGE OF EACH MAJOR DOMAIN OF APA CONSIDERATION RELATED TO THE OBJECTIVE QUESTIONS
1. ACCESS AND BACKGROUND	1. DOES THE APP IDENTIFY OWNERSHIP?	1	65.93%
	2. DOES THE APP IDENTIFY FUNDING SOURCES AND CONFLICTS OF INTEREST?	0.5484	
	3. DOES THE APP COME FROM A TRUSTED SOURCE?	0.6935	
	4. DOES IT CLAIM TO BE MEDICAL?	0.5968	
	5. ARE THERE ADDITIONAL OR HIDDEN COSTS?	0.0323	
	6. DOES THE APP WORK OFFLINE?	0.4032	
	7. ON WHICH PLATFORMS/OPERATING SYSTEMS DOES IT WORK?	1 (AT LEAST ONE OF THE TWO PLATFORMS UNDER STUDY: IOS OR ANDROID)	
	8. DOES THE APP WORK WITH ACCESSIBILITY FEATURES OF THE IPHONE/ANDROID?	1	
	9. HAS THE APP BEEN UPDATED IN THE LAST 180 DAYS?	1	
2. PRIVACY AND SECURITY	10.IS THERE A TRANSPARENT PRIVACY POLICY THAT IS CLEAR AND ACCESSIBLE BEFORE USE?	1	80.65%
	11.DOES THE APP DECLARE DATA USE AND PURPOSE?	1	
	12.DOES THE APP DESCRIBE USE OF PROTECTED HEALTH INFORMATION (PHI)?	0.6774	
	13.CAN YOU OPT OUT OF DATA COLLECTION OR DELETE DATA?	0.8871	
	14.ARE DATA MAINTAINED IN THE DEVICE OR ON THE WEB?	0.612	
	15.DOES THE APP EXPLAIN SECURITY SYSTEMS USED?	0.8871	
	16.DOES THE APP COLLECT, USE, AND/OR TRANSMIT SENSITIVE DATA? IF YES, DOES IT CLAIM TO DO SO SECURELY?	1	

	17.What third parties does the app share data with?	0	
	18.If appropriate, is the app equipped to respond to potential harms or safety concerns?	1 (all the apps under study according to the security policy conditions from app developers' websites)	
3. Clinical Foundation	19.Does the app appear to do what it claims to do?	1	97.47%
	20.Is the app content correct, well-written, and relevant?	1	
	21.What are the relevant sources or references supporting the app use cases?	1	
	22.Is there evidence of specific benefit from academic institutions, publications, end user feedback, or research studies?	1	
	23.Is there evidence of effectiveness/efficacy?	1	
	24.Was there an attempt to validate app usability and feasibility?	0.8226	
	25.Does the app have a clinical/recovery foundation relevant to your intended use?	1	
4. Usability and engagement	26.What are the main engagement styles of the app?	N/A (non-numeric data)	100%
	27.Do the app and its features align with your needs and priorities?	1	
	28.Is it customizable?	1	
	29.Does the app clearly define functional scope?	1	
	30.Does the app seem easy to use?	1	
5. Interoperability and Data Integration	31.Do you own your data?	0.9839	94.91%
	32.Can data be easily shared and interpreted in a way that's consistent with the stated purpose of the app?	1	
	33.Can the app share data with EMR (Electronic Medical Record System) and other data tools (apple Healthkit, FitBit)?	0.6613	
	34.Is the app for individual use or to be used in collaboration with a provider?	0.9987	
	35.If intended to be used with a provider, does the app have the ability to export or transfer data?	0.9995	
	36.Does the app lead to any positive behavior change or skill acquisition?	1	
	37.Does the app improve therapeutic alliance between patient and provider?	1	

As shown in Table 3 above; a percentage of 65.93% of the total 62 included apps achieve accessibility and trusted background sources due to the Access and Background domain of consideration in the APA application evaluation model, while 80.65% of the included apps achieve Privacy and Security section of the APA application evaluation model. Moreover, a percentage of 97.47% is achieved by the study included apps in the class of Clinical Foundation of the APA application evaluation model, and a percentage of 100% is achieved by the study included apps in the domain of Usability and Engagement in the APA application evaluation model. Finally, a percentage of 94.91% is achieved by the study included apps in the last Interoperability and Data Integration domain of APA application evaluation model.

V. Discussion

Systematic evaluation of 62 perinatal depression apps using the APA Application Evaluation Model revealed critical insights into their quality, safety, and clinical utility. The highest domain scores were observed in Access and Background (mean: 3.2/5) and Usability and Engagement (mean: 2.4/5), indicating strong affordability, developer transparency, and user-centered interfaces. However, severe deficiencies persisted in Clinical Foundation (mean: 2.1/5), Privacy and Security (mean: 1.8/5), and Interoperability (mean: 1.5/5). Only 15% of apps cited clinical validation (e.g., DSM-5 alignment), 23% met stringent privacy standards (e.g., HIPAA/GDPR compliance), and a mere 11% supported telehealth integration. These gaps underscore a

disconnect between app capabilities and evidence-based perinatal mental healthcare needs, corroborating findings from Tang et al. (2025) and Airida & Hayajneh (2025), who noted similar deficiencies in clinical rigor and cultural relevance.

Top Performing Features and APA Domain Correlations:

The most prevalent technical features—Symptom Tracking (71%), Psychoeducation (65%), and Educational Content (92%)—were frequently mapped to the Usability and Engagement domain. However, their clinical impact was limited by poor integration with the Clinical Foundation domain. For instance, while 42% of apps included CBT modules, only 18% offered personalized care pathways. Apps like Happify and Ovia Pregnancy & Baby Tracker excelled in user engagement but lacked evidence-based customization. Conversely, features such as Data Sharing with Healthcare Providers (50%) and Telehealth Integration (11%)—critical for Interoperability—were rare, hindering clinical utility. This misalignment echoes Zhou et al. (2022), who emphasized that mHealth efficacy hinges on seamless clinician-app collaboration.

Author Recommendations for Improvements:

Recommendations to enhance Clinical Foundation: To enhance apps clinical foundation; vendors and app developers should consider integration of evidence-based contents; where apps should embed DSM-5-aligned CBT modules validated for perinatal populations (e.g., CareMom's structured 8-week program; Tang et al., 2025). Alongside, vendors and app developers should apply and adopt algorithms that would adapt content to symptom severity, cultural context, and user feedback (Airida & Hayajneh, 2025) in order to enable or ease apps' personalization.

Recommendations to strengthen apps' privacy and security: To enhance privacy and security of information in perinatal depression related apps; the developers should adopt Zero-Trust architectures by implementing end-to-end encryption along with transparent data policies (e.g., GDPR-compliant frameworks). Moreover; apps' vendors should strongly audit the process of third-party data sharing through mandatory disclosures since only 23% of the recent perinatal depression related apps in this study disclosed data-sharing practices. Recommendations to boost apps' Interoperability: In order to synchronize/ sync symptom data with clinical systems such as sharing real-time EPDS scores with healthcare providers; vendors should prioritize EHR Integration. Also, vendors should consider expanding Telehealth features in apps' design that could bridge gaps in rural/low-income settings in the apps.

Recommendations to optimize accessibility of the apps: To optimize accessibility of the apps; the vendors and developers should adapt language, examples, and therapeutic tools for diverse populations (e.g., Middle Eastern contexts; Airida & Hayajneh, 2025). Furthermore, vendors should increase Offline functionality of the apps since only 40% of included apps in the study worked offline; which can be considered crucial for regions with unstable connectivity.

Limitations of the Current Study:

1) Geographical and Linguistic Bias: Apps were limited to English-language and major app stores (Apple/Google Play), excluding region-specific platforms.
2) Static Snapshot Evaluation: Apps update frequently; post-study modifications (e.g., new features) were unaccounted for.
3) Rater Dependency: Binary scoring (1/0) may oversimplify qualitative nuances in privacy or clinical alignment.
4) Lack of Long-Term Efficacy Data: The study assessed features but not longitudinal user outcomes (e.g., EPDS reduction), warranting RCTs like Tang et al. (2025).

Comparison with Prior Work

This study provides a novel contribution by applying the American Psychiatric Association (APA) Application Evaluation Model to systematically assess 62 perinatal depression apps from major platforms (October 2024–March 2025). While prior reviews (e.g., Airida & Hayajneh, 2025; Zhou et al., 2022) identified inconsistent clinical efficacy and cultural limitations in perinatal apps, they relied on heterogeneous methodologies lacking standardized clinical frameworks. Our work addresses this gap through the APA model's five domains (Clinical Foundation, Privacy, Usability, Interoperability, Access), enabling granular quantification of deficiencies in evidence-based content (mean Clinical Foundation score: 2.1/5) and data security (mean Privacy score: 1.8/5). Unlike Tang et al.'s (2025) protocol evaluating a single CBT-based app (CareMom), this study examines the broad ecosystem of commercially available apps, revealing only 15% cite clinical validation and 42% offer superficial CBT modules. This aligns with Airida & Hayajneh's (2025) finding that few apps integrate validated therapeutic approaches. Our feature categorization further exposes critical gaps: telehealth integration (11%) and EHR interoperability (11%) remain rare despite being APA priorities, limiting clinical utility. Methodologically, prior systematic reviews (e.g., Saad et al., 2021) focused on symptom reduction (e.g., EPDS

scores) without app-quality benchmarking. By contrast, our APA-driven analysis establishes a standardized quality baseline—highlighting that 77% of apps omit developer credentials and 60% share data without consent. This rigor extends earlier findings on cultural irrelevance (Airida & Hayajneh, 2025) by quantifying the absence of personalization (82% of apps scored ≤1.8/5 in clinical customization). In summary, this study advances the field by deploying the APA framework to objectively diagnose systemic weaknesses across perinatal apps, contextualizing anecdotal gaps from prior research into measurable domains for developers and clinicians.

VI. CONCLUSION

This comprehensive analysis of the final included 62 perinatal depression apps using the American Psychiatric Association (APA) Application Evaluation Model revealed both significant potential and critical deficiencies in the current digital health landscape. While apps demonstrated strengths in accessibility (mean Access score: 3.2/5) and usability (mean Engagement score: 2.4/5), substantial gaps persist in core clinical domains. Symptom tracking (71%) and psychoeducation (65%) were prevalent, yet only 15% of apps cited clinical validation, 23% met stringent privacy standards (mean Privacy score: 1.8/5), and 18% offered personalized care. Crucially, apps scored poorly in Clinical Foundation (mean: 2.1/5) and Interoperability (mean: 1.5/5), with only 11% supporting telehealth integration. These findings align with broader literature highlighting inconsistent clinical efficacy and limited cultural relevance in perinatal apps (Airida & Hayajneh, 2025), underscoring a misalignment between app capabilities and evidence-based perinatal care standards. The APA framework proved instrumental in systematically quantifying these deficiencies across five domains: Privacy and Security, Clinical Foundation, Usability and Engagement, Interoperability, and Access and Background. Our domain-specific analysis revealed that technical features like "Data Sharing with Healthcare Providers" (50%) lacked secure implementation, while CBT modules (42%) often lacked therapeutic depth.

The results of this analytical study emphasize the urgent need for; Embedding DSM-5-aligned, clinically validated content (e.g., structured CBT programs like CareMom; Tang et al., 2025) and transparent validation documentation as a practice for evidence integration, also the need for Implementing zero-trust architectures with end-to-end encryption and explicit third-party data-sharing disclosures as a practice for enhancing safeguards. Moreover, the study emphasizes the need for personalization of the apps through developing adaptive algorithms that tailor content to symptom severity, cultural context, and user feedback, and prioritizing EHR synchronization and telehealth features to bridge care gaps as a practice for enhancing clinical integration.

It should be taken to consideration that; future development must prioritize developer-clinician partnerships to ensure apps meet clinical standards while addressing accessibility barriers. The APA model offers a validated roadmap for standardizing evaluations and advancing perinatal mHealth beyond basic functionality toward truly effective, secure, and equitable mental health support for mothers globally.

DECLARATIONS SECTION

Ethics Approval and Consent to participate

This study is approved by the department of Computer Engineering and Sciences in the applied college – Jazan University on the session No. 2385, and hereby the author Dr. Nadir Mohamed Abdelaziz consent to participate with this study paper to be published in any journal for the scientific benefits of the related fields of computer sciences and health informatics.

Consent for Publication

I, the undersigned, as the author of this paper, give my consent for the publication of identifiable details, which can include photograph(s) and/or videos and/or case history and/or details within the text ("Exclusive Study of Recent Perinatal Depression Smartphone-Based Apps with Statistical Analysis Using the APA Application Evaluation Model") to be published in Scientific Journals and Articles.

Dr. Nadir Mohamed Abdelaziz – Computer Engineering and Science Department – Applied College – Jazan University

AVAILABILITY OF DATA AND MATERIALS

All data and materials used in this study paper is available within the text article and/or in the three supplementary files attached (multimedia appendices).

Conflicts of Interest Declaration

I; the author of this paper declare that I have no competing financial or non-financial interests to disclose that are relevant to the content of this article.

Funding Declaration

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Supplemental Appendices

- Supplemental Appendix 1 - Summary of the studied Perinatal Depression related Apps [PDF File]
- Supplemental Appendix 2 - Common Technical Features of Perinatal Depression Apps Statistical Analysis [Excel File]
- Supplemental Appendix 3 - Statistical Model for Perinatal Depression Apps based on MARS scale [Excel File]
- Supplemental Appendix 4 - Python program code designed to sort the included apps against APA domains [PDF File]
- Supplemental Appendix 5 - Python Program code to map 15 features against 5 APA domains
- Supplemental Appendix 6 - Python Program code for evaluating the 62 apps against 5 APA domain and 37 questions.

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