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Mental Health Disorders with Psychosis in Pregnant and Non-Pregnant Women in Sub-Saharan Africa

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Abstract

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Maternal mental health is a persisting global maternal child health issue; however, this area remains under-researched, especially pertaining to psychosis disorders in African populations. Using the Neuropsychiatric Genetics in African Populations Psychosis (NeuroGAP-Psychosis) Study data, this exploratory analysis aims to examine the prevalence of mental health disorders with psychosis (MHP), such as schizophrenia and bipolar disorder, among pregnant and non-pregnant women and to characterize covariates that are associated with MHP conditions. The data included female participants from Ethiopia (n = 13,000), Kenya (n = 8,355), Uganda (n = 9,598), and South Africa (n = 12,000). Overall, the prevalence of MHP diagnosis among pregnant and non-pregnant women is 37.7% and 49.7% respectively. Schizophrenia diagnosis ranged from 18.3% to 26.9% and bipolar/mania diagnosis from 19.3% - 22.8%. Three binary logistic regression models were used in this study to examine the association between pregnancy and psychosis. Pregnant women who were married were 60% less likely (OR 0.4; 95% CI: 0.25-0.63) to experience MHP and non-pregnant women who were married were 51% less likely (OR 0.49, 95% CI 0.46-0.52) to experience MHP compared to their single/divorce/widowed counterparts. Using women with a college level education as the reference group, women with primary or below (Pregnant: OR 1.76, 95% CI 1.05-3.00; Non-Pregnant: OR 1.87, 95% CI 1.72-2.04) or secondary school education (Pregnant: OR 2.00, 95% CI 1.21-3.37; Non-Pregnant: OR 1.66, 95% CI 1.53-1.79) were more likely to experience MHP. Additional research is needed to identify other potential covariates that are country and population specific and can be used to inform future research that can enact change in care for women.

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Introduction

Maternal mental health has been recognized in both the Millennium Development Goals and its successor, the Sustainable Development Goals, as a crucial element in addressing maternal child health in international communities (MDGs, 2000; SDG Target 3.1, 2015). However, little has been done to address these health concerns, especially in African populations that are experiencing psychiatric disorders. This exploratory analysis will use data from the Neuropsychiatric Genetics in African Populations - Psychosis Study to assess psychiatric disorders in pregnant women and use findings to inform future research.

The Neuropsychiatric Genetics in African Populations - Psychosis Study (NeuroGAP-Psychosis) is a global neuropsychiatric genetics initiative that aims to improve the diagnosis and treatment of psychiatric disorders by expanding the research findings and genetics infrastructure in Africa – a continent with great levels of human genetic diversity (Stevenson et al., 2019). Questionnaires and saliva samples were collected from 42,953 participants at study sites in Addis Ababa University in Ethiopia, Makerere University in Uganda, Moi University and KEMRI-Wellcome Trust in Kenya, and University of Cape Town in South Africa. The research conducted at these study sites focused on the genetics of psychosis-related mental health disorders, such as schizophrenia and bipolar disorder. NeuroGAP-Psychosis sought to expand the genetic analysis of serious mental illness by advancing global health equity and by increasing research capacity in Africa. Using the NeuroGAP-Psychosis Study data will allow us to assess the prevalence of mental health disorders with psychosis (MHP), such as schizophrenia and bipolar disorder, among pregnant participants in the NeuroGAP-Psychosis study and compare the results to non-pregnant participants. Secondary analysis of de-identified data was considered non-human subjects research and Emory IRB review was not required.

The objective of this thesis is to conduct an exploratory analysis of MHP among women in sub-Saharan Africa. The first objective is to examine the prevalence of MHP among pregnant and non-pregnant women in the present NeuroGAP-Psychosis study sites in Ethiopia, Kenya, Uganda, and South Africa and to better understand how these conditions are distributed amongst the study population. The second objective is to characterize covariates, such as age, marital status, and education, which are associated with mental health conditions, specifically psychosis, in pregnant women. This will provide insight on other factors that may be associated with MHP that may be unique to the region or pregnant populations. In doing so, we hope to encourage further research in this topic area as well as in this specific population.

Literature Review

Over the past 20 years, the association between maternal mental health and maternal deaths has received more attention (Paschetta et al., 2014). In the early 2000s, reports in the British Confidential Enquiries into Maternal Deaths indicated that perinatal mental health conditions in the United Kingdom were one of the leading causes of maternal mortality during the first year of postpartum, contributing to 12% of maternal deaths from 2003 to 2005 (Cantwell et al., 2011; Paschetta et al., 2014). Many of these deaths can be attributed to the correlation between psychotic illness and suicide, though more research is required to determine its prevalence globally (Adjorlolo et al., 2022; Paschetta et al., 2014). This prompted an influx of changes in clinical management systems and health policies in the United Kingdom to ensure that women were receiving the best possible care. According to Paschetta et al. (2014), these systematic changes resulted in a reduction in maternal mortality, but it is unclear how the changes made to the services provided affected other areas in maternal, fetal, and child health outcomes. Though

there are studies that have assessed perinatal mental health conditions in western countries, data representing similar issues in non-western countries is either unknown or under-researched, especially in African populations.

Most of the global literature on topics concerning maternal mental health is based in Western countries. According to Sawyer et al. (2010), Halbreich & Karkun (2006) is the only paper to conduct a worldwide review which focused on maternal mental health issues, like postnatal depression. Halbreich & Karkun (2006) included 143 studies and reported the prevalence of postnatal depression in 40 countries, including, but not limited to: the United States, Guyana, Costa Rica, Italy, South Africa, Taiwan, India, Turkey, Ireland, Lebanon, Morocco, Finland, Nigeria, New Zealand, and Uganda. The prevalence rates ranged from almost 0% in countries like Singapore, Malta, Denmark, and Malaysia to 60% in countries like Guyana, Costa Rica, Italy, Chile, South Africa, Korea and Taiwan (Halbreich & Karkun, 2006; Sawyer et al., 2010). This vast range in prevalence can be exacerbated by the complex nature of cross-cultural research, especially when using Western diagnostic classification systems of depression that may not be accurate when applied to non-Western countries (Sawyer et al., 2010). Despite this discrepancy, the review was still helpful in identifying gaps in current research (Sawyer et al., 2010). Though this systematic review does highlight studies that incorporated African populations, this review did not provide current or specific information related to these countries and the prevalence of psychosis in their pregnant populations. This further calls attention to how research surrounding maternal mental health topics are limited on a global scale.

According to Fisher et al. (2012), women from low- and middle- income countries have not been present in perinatal mental health research, as more attention was given to preventing pregnancy-related deaths rather than mental health issues. Reports have shown that low- and

middle- income countries tend to have higher rates of perinatal psychiatric disorders compared to high-income countries and less than 8% of these women are receiving the mental health care they need (Fisher et al., 2012; Paschetta et al., 2014). Some studies have indicated that this can be attributed to a variety of socioeconomic and intermediary determinants (Fisher et al., 2012). These conditions are often diagnosed through the use of psychiatric evaluations, laboratory testing, and brain scans (Psychosis, 2024). Mental health awareness and screening is crucial in all populations, but especially in maternal and child health in low- or middle-income countries. This literature review will look at prevalence of mental illness in low- and middle- income countries and ascertain information pertaining to pregnant women's experiences with psychiatric disorders.

In the current literature, most quantitative studies that analyze mental disorders during pregnancy tend to focus on perinatal common mental disorders rather than psychotic disorders (Ng'oma et al., 2020). Common mental disorders are defined as "a group of distress states manifesting with anxiety, depressive and unexplained somatic symptoms typically encountered in community and primary care settings" (Risal, 2011, p. 213). Though these conditions are important and will be mentioned in this paper, this literature review will focus on psychosis and psychiatric disorders. Due to the lack of existing literature on psychotic disorders, the articles in this review addressing common mental disorders will be used to supplement the main topics of this paper.

Psychosis is not a disorder, but rather a set of symptoms that can affect a person's mental state and their perception of reality (Understanding Psychosis - NIMH, 2024). Symptoms can include delusions, hallucinations, and disorganized thinking and behavior. Although psychosis is perceived as a symptom of other mental health disorders, the development of psychosis does not

reliably allude to the presence of any particular medical condition or mental illness. The cause of psychosis remains unknown, but it appears to be associated with a combination of genetics, brain development and exposure to trauma (Understanding Psychosis - NIMH, 2024).

The NeuroGAP-Psychosis study conducted genome-wide association studies (GWAS) in Ethiopia, Kenya, South Africa, and Uganda to better understand the genetic diversity present in these countries and how these genetic differences may affect how psychiatric disorders present themselves in these populations. The Eurocentric bias in GWAS and advances in understanding the genetic aspect of psychiatric disorders, such as schizophrenia and bipolar, produces studies that are not generalizable to African populations and contributes to the growing health disparities in diagnosing and treating these conditions (Atkinson et al., 2022; Stevenson et al., 2019). Using the NeuroGAP-Psychosis data will allow us to ascertain the prevalence of psychiatric disorders in predominately African populations and better inform research on perinatal mental health disorders on the continent.

Prevalence in Africa

The prevalence of mental health conditions varies across studies. Studies assessing the prevalence of perinatal common mental disorders have shown that despite the lack of data previously available for African countries, Africa has a similar prevalence rate of these conditions compared to high-income countries and other low- and middle-income regions (Ng'oma et al., 2020). Sawyer et al. (2010) conducted a systematic review to ascertain the prevalence and determinants of maternal mental health disorders present in women in Africa. Overall, 35 studies were included, representing eight African countries and 10,880 participants in total. It is important to note that most of the studies were conducted in Nigeria (n=19). Poor

general psychological health during pregnancy ranged from 12.5% to 30.2% in six studies and after childbirth ranged from 6.1% to 33% in five studies respectively (Sawyer et al., 2010). Depression was the most common mental health disorder assessed during pregnancy and after birth, with a weighted mean prevalence of 11.3% (95% CI 9.5%-13.1%) and 18.3% (95% CI 17.6%-19.1%) respectively (Sawyer et al., 2010). Fisher et al. (2012) also conducted a systematic review to assess the prevalence and determinants of non-psychotic common perinatal mental disorders among women living in low- and lower-middle income countries. Forty-seven papers were included in their final analysis and the authors identified various methodologies and endpoints used to assess non-psychotic common perinatal mental disorders. Many of the articles that focused on the mental health of pregnant women focused on non-psychotic common perinatal mental disorders. Fisher et al. (2012) determined that common perinatal mental disorders were more prevalent in low- and middle-income countries, especially among women with lower socioeconomic status, gender-based risk (e.g. bias against female babies, excessive unpaid workloads, gender-based violence, etc.) or a history of psychiatric conditions (Fisher et al., 2012). Though Fisher et al. (2012) does not specifically discuss psychiatric disorders, this article can be used to better understand the mental health disorders in the region, given a lack of data from the African context.

Paschetta et al. (2014) discussed the prevalence of mental health disorders that are common during the perinatal stage and the policies for prenatal screening to diagnose women at risk of developing these conditions. According to this review, the lifetime prevalence of schizophrenia is approximately 1-2% (Paschetta et al., 2014). Adjorlolo et al. (2022) conducted a cross-sectional study to determine the prevalence of psychotic-like experiences among pregnant women in Ghana. Psychotic-like experiences are defined as “subclinical symptoms of psychosis

that do not meet the threshold for clinical diagnosis as psychotic illness" (Adjorlolo et al., 2022, p. 2). In this study, 702 pregnant women that were not diagnosed with a mental disorder were surveyed to gather measures of psychotic-like experiences, COVID-19 concerns, and behavior maladies. The results indicated that psychosis could pose a risk during pregnancy. The survey showed that 27.3% of participants were at moderate risk for psychosis while 18.5% of participants were at high risk for psychosis. Although 44.4% of participants were not distressed by psychotic-like experiences, 32.2% were a bit/quite distressed and 23.4% were very distressed. This paper further emphasized the importance of screening for psychosis risk during pregnancy, especially for pregnant women that have behavioral maladies, such as: depressive symptoms, sleep difficulty, and others. Though the information surrounding psychosis is limited, there are studies that provide insight on potential risk factors for perinatal mental disorders and other mental health conditions.

Risk Factors

There are a wide range of risk factors that contribute to mental health conditions. For common mental disorders, risk factors include low socioeconomic status, gender disadvantages, poor physical health and nutrition, and psychological illness (Patel et al., 2006; Risal, 2011). In a study conducted in India, Patel et al. (2006) found that women were more likely to develop common mental disorders if they were married during adolescence, experienced reduced autonomy, not involved in social activities, and received little familial support. Violence, unwanted sex with one's husband, and concerns about their husband's other sexual relationships also increased women's risk of developing common mental disorders (Patel et al., 2006). These gender disadvantages seem to exacerbate mental illness in women. Though this study was

conducted in India, looking at other sources from other low- and middle-income countries allows us to supplement the lack of data from the African context and inform future perinatal mental health research.

According to the literature, common mental disorders and perinatal mental disorders (e.g. anxiety disorders, postpartum psychosis, post-traumatic stress disorder, and suicide), though different, have shared risk factors. Risks factors for perinatal mental disorders include, but are not limited to: past history of psychiatric disorders, biological factors (genetic, hormonal, etc.), recent adverse life events, low socioeconomic status, insufficient emotional/social support, unfavorable obstetric/neonatal/pregnancy outcomes, intimate partner violence, and history of physical/sexual abuse (Adjorlolo et al., 2022; Fisher et al., 2012; Ng'oma et al., 2020; Paschetta et al., 2014; Sawyer et al., 2010). Paschetta et al. (2014) argued that the extensive list of risk factors points to the need for the screening of psychiatric symptoms at the initial prenatal visit. If it can be brought to the attention of health professionals early-on, they can better provide care to expecting mothers and their children. They also recommended a multidisciplinary model for providing care to women with perinatal mental disorders or those that are at risk of relapse. This level of attention and care can help identify those at risk of mental disorders sooner and develop a specialized treatment plan. However, low healthcare capacity and resources also contribute to the difficulty for women who are experiencing severe mental illness to receive the care that they need (Ng'oma et al., 2020). The inability to diagnose and treat perinatal mental disorders early-on only exacerbates the prevalence of psychosis and the consequences of it going untreated in pregnant populations.

Consequences of Perinatal Mental Disorders

Studies have shown that pregnancy can have a negative effect on women predisposed to or with a history of mental illness. Pregnancy has been associated with the initial onset or potential relapse of mental health disorders. Bipolar Affective Disorder (BPAD) is likely to reoccur in up to 50% of women with a history of BPAD, but especially after childbirth during the first two weeks of postpartum (Paschetta et al., 2014). Women with a history of schizophrenia have approximately 24-25% risk of relapse during the first three months postpartum, especially if they discontinued their treatment plan (Paschetta et al., 2014). According to Ng'oma et al. (2020), studies conducted in Africa have shown that perinatal common mental disorders can be a risk factor for prolonged labor and delayed breastfeeding initiation (Ng'oma et al., 2020). These consequences can influence the health outcomes of both mother and child.

It is also important to address the direct effect maternal mental health has on their offspring. Perinatal mental disorders can have irreversible effects on the child if not diagnosed and treated in a timely manner. According to Ng'oma et al. (2020), perinatal common mental disorders have been associated with impaired intrauterine and can put a child at risk of impaired fetal or infant growth. Current guidelines and policies in Africa are unable to effectively delineate the appropriate care pathways to address severe mental illness in women (Ng'oma et al., 2020). Perinatal mental illness influences the mother's health as well as the child's birth outcomes and development (Paschetta et al., 2014). For example, 242 depressed mothers in Nigeria were enrolled in a longitudinal case-controlled study to assess the relationship between poor mental health and infant malnutrition and physical health. According to Adewuya et al. (2008), the study showed that infants with depressed mothers experienced significantly poorer growth results than their counterparts with non-depressed mothers postpartum at three months

(weight OR 3.41, 95% CI 1.30–8.52; length OR 3.28, 95% CI 1.03–10.47), six months (weight OR 4.21, 95% CI 1.36–13.20; length OR 3.34, 95% CI 1.18–9.52) (Adewuya et al., 2008; Sawyer et al., 2010). If not addressed, perinatal mental disorders can have lasting effects on a child's growth and development; thus, capping the child's future potential. Though this does not indicate that the child will develop a psychiatric condition, it is important to emphasize that psychosis in untreated pregnant women and mothers can have a lasting effect on their child's wellbeing if not diagnosed as soon as possible.

Larger Context & Research Gaps

As shown through the literature, perinatal mental health disorders are a prominent public health issue in both high- and low-income countries. Unfortunately, perinatal mental health conditions, such as postpartum psychosis, post-traumatic stress disorder, suicide, and anxiety disorders, are still understudied and African countries and populations are underrepresented in this research (Ng'oma et al., 2020). A majority of the global research that has been conducted on this topic is over ten years old. Since then, little progress has been made to advance what is known about perinatal mental health conditions. According to Adjorlolo et al. (2022), psychotic illness is rarely reported during the perinatal period and the study of psychotic-like experiences during pregnancy has an insufficient amount of empirical data to advance the field or improve the current practices and policies in place regarding pregnancy services. Even so, the data that is available does imply that the prevalence rates and burden of psychosis during the perinatal period is alarming (Adjorlolo et al., 2022). Though inferences can be made based on the available data, that is not enough to address the current burden of mental illness. Other limitations include inconclusive findings when assessing the relationship between

sociodemographic, obstetric, and mental health factors, many of the studies were cross-sectional, and the measures used across studies varied greatly (Sawyer et al., 2010). The current study aims to fill this gap by using data collected from African countries and examining psychotic disorders present within pregnant populations found in these countries.

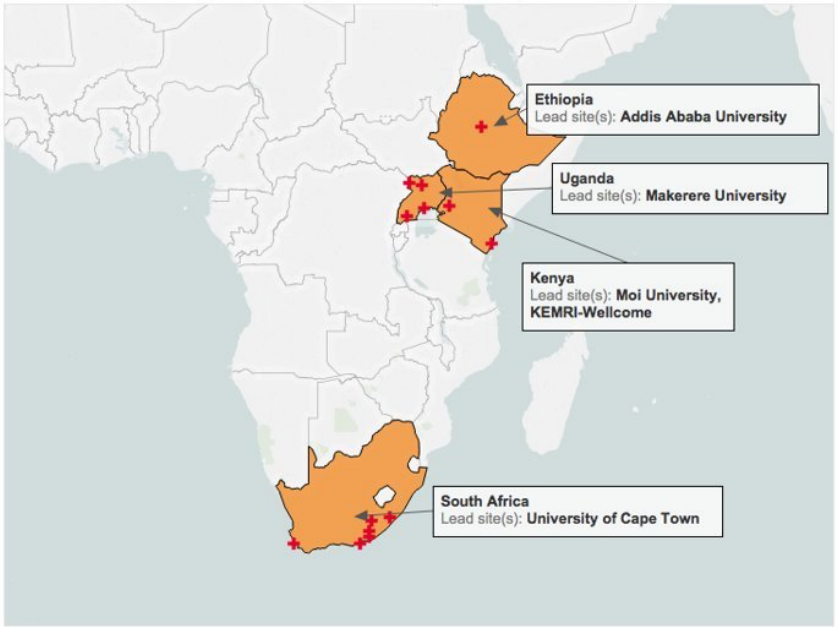
Methods

The NeuroGAP-Psychosis study was a case-control study of 42,953 participants that was structured around two psychotic disorders: schizophrenia and bipolar disorder. Though the study recorded if other mental disorders were present in the study populations, the researchers focused on these conditions due to the literature displaying a strong correlation and genetic heritability between schizophrenia and bipolar disorder (Cardno & Owen, 2014; Stevenson et al., 2019). Cases were defined as participants in the NeuroGAP-Psychosis study that had a clinician-confirmed diagnosis of schizophrenia, bipolar, or other present forms of psychosis, such as mania, schizoaffective and psychotic disorder. Controls were defined as participants that did not have a clinician-confirmed diagnosis. Places of recruitment for controls varied by study site. Most recruitment took place at general medical facilities where controls were approached in the same manner as cases and likely consisted of people seeking out clinical care for themselves, accompanying a loved one to a clinic visit, or picking up a medication refill (Stevenson et al., 2019). When conducting the study, controls were matched based on geographical location, age, sex, and ancestry (Stevenson et al., 2019).

The study started in February 2018 and ended in March 2023. Study sites for this project were chosen based on their existing work in psychiatric research, research capacity, infrastructure, trusted relationships from previous collaborations, and their vast levels of genetic

diversity which can be used to better inform this field of study (Stevenson et al., 2019). The study sites were in Addis Ababa University in Ethiopia, Makerere University in Uganda, Moi University and KEMRI-Wellcome Trust in Kenya, and University of Cape Town in South Africa.

Figure 1:



Nations represented in NeuroGAP-Psychosis. (*Map data: NeuroGAP. Credit: Tom Ulrich, Broad Communications.*)

Participant recruitment at multiple hospital sites within each country and eligible participants were identified based on their available medical records (Stevenson et al., 2019). The inclusion and exclusion criteria for the NeuroGAP-Psychosis study can be found in Table 1.

Table 1: NeuroGAP-Psychosis study Inclusion/Exclusion Criteria

Inclusion Criteria	Exclusion Criteria	
All participants (cases and controls) will be required to provide: ● Written informed consent or a fingerprint in case of illiteracy University of California, San Diego Brief Assessment of Capacity to Consent (UBACC) ● Must be at least 18 years old. Cases: ● Confirmed by clinician referral and/or medical record review	Individuals (cases) will be excluded if the following are present: ● Absence of a diagnosis of a psychotic disorder. ● Severe, intrusive levels of psychiatric symptoms at the time of consent. ● Intoxication or withdrawal from alcohol or substance abuse at the time of consent. ● A current psychiatric hospitalization (inpatients). (Only in Kenya and Uganda) ● Involuntary detention at the time of consent. ● Lack of fluency in one of the languages the consent form has been translated into. ● Lack of capacity to consent to the study as determined by the UBACC.	Potential controls will be excluded if they: ● Have current psychotic symptoms or a past diagnosis of a psychotic disorder. ● Are currently taking medication for psychosis. ● Have acute levels of alcohol or substance misuse as demonstrated by being a current inpatient or under acute medical care for substance misuse. ● Lack of fluency in one of the languages the consent form has been translated into. ● Lack of capacity to consent to the study as determined by the UBACC.

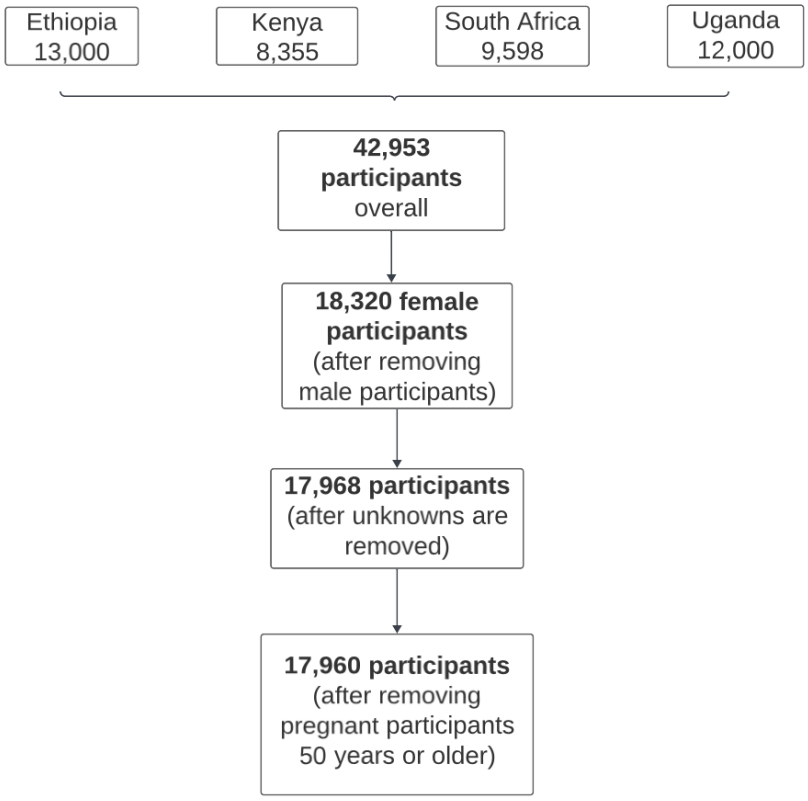
Citation: Stevenson, A., Akena, D., Stroud, R. E., Atwoli, L., Campbell, M. M., Chibnik, L. B., Kwobah, E., Kariuki, S. M., Martin, A. R., Menil, V. de, Newton, C. R. J. C., Sibeko, G., Stein, D. J., Teferra, S., Zingela, Z., & Koenen, K. C. (2019). Neuropsychiatric Genetics of African populations-psychosis (Neurogap-psychosis): A case-control study protocol and GWAS in Ethiopia, Kenya, South Africa and Uganda. BMJ Open, 9(2), e025469. https://doi.org/10.1136/bmjopen-2018-025469

Once a participant was identified, the University of California, San Diego Brief Assessment of Capacity to Consent (UBACC) was administered by a research assistant to obtain and establish consent. A series of phenotyping tools were used in this study, but this exploratory analysis mainly focused on the Chart Review (psychosis diagnosis for cases), K-10 results (proportion of psychological distress in controls), Life Events Checklist (LEC) and ASSIST (measures levels of substance abuse). Selecting these tools allowed us to pinpoint which factors would be best to include in the analysis.

Using the R (V. 3.3.0) and RStudio (V. 2023.12.0+369) programming software, the final dataset for each country was imported and cleaned in preparation for data analysis. For this study, the population of interest is pregnant and non-pregnant participants. As shown in Figure 2, male participants were filtered out of the working dataset. Once the dataset only contained

female participants, participants with unknown pregnancy status and pregnant women over the age of 50 (n=8) were excluded.

Figure 2:



Then, a table was created to visually display the participant demographic breakdown of the female study population (see Table 2). In this paper, 17,960 participants were included in the data analysis.

Variable Coding Strategy

Categories with less than 5% relative frequency were classified together. For the psychosis variable, categories were determined based on similarities that each mental health disorder shares

in consultation with a licensed mental health professional. Bipolar and mania disorders were grouped together because these conditions do not always include or require a psychotic experience for diagnosis. Schizophrenia, schizoaffective, psychotic disorder each require psychotic symptoms for diagnosis, thus resulting in these conditions being categorized together. Other attributes that were included in the analysis, such as marital status and education level, were collapsed to enhance clarity in the table presentation, and then further collapsed to ensure that most of the variables that are included in the model are at least 5% (Figure 3).

Figure 3:

	Original Categories	Table 1 Categories	Logistic Regression Model Categories
Education	No Education Some Primary School Finish Primary School Some Secondary School Finished Secondary School Some College Finished College	No Education Primary School Secondary School College	No Education - Primary School Secondary School College
Marital Status	Married Living Together Divorced/Anulled Separated Widowed Never Married	Married/Life Partner Divorced/Separated/Widowed Never Married	Married Single
Psychosis Diagnosis	Bipolar Mania Psychotic Disorder Schizophrenia Schizoaffective	Bipolar/Mania Schizophrenia	Bipolar/Mania Schizophrenia

Prevalence was used to understand the relative severity of the mental health issue in pregnant and non-pregnant participants for each psychosis diagnosis category (bipolar/mania and schizophrenia) and for overall psychosis diagnosis within each study country.

Modeling

Three binary logistic regression models are used in this study to examine the association between pregnancy and psychosis. Model 1 assessed mental health disorders with psychosis (MHP) in pregnant participants, assigning pregnant women with a MHP as the reference group of outcome. Model 2 assessed MHP in non-pregnant participants where non-pregnant women with a MHP diagnosis are the reference group of outcome. Model 3 examined the differences among MHP between those who were pregnant and not pregnant. In this model, pregnant women with a MHP diagnosis are set as the reference group of outcome.

Education level, marital status, age, and study country were adjusted for in each model. These models did not seek statistical significance and were instead developed to assess the strength of the relationships between diagnosed psychosis and covariates collected in this study. In doing so, factors that may be unique to the region or pregnant populations are identified and can encourage further research in this topic area as well as in this specific population.

Results

Table 2, below, provides an outline of the demographic characteristics across the study cohort. Overall, there were 8,867 cases and 9,093 controls included in this paper. The mean age across study sites was 37.4 years old in non-pregnant women and 30.0 in pregnant women. Out of 17,453 non-pregnant participants, 35.9% of participants were married or living with a life partner, 24.8% participants had attended college, and 49.7% of participants were diagnosed with a MHP. Out of 507 pregnant participants, 75.3% of participants were married or living with a life partner, 24.7% participants had attended college, and 37.6% of participants were diagnosed with a MHP.

Table 2: Characteristics of Female Participants from the NeuroGAP-Psychosis Study

	Ethiopia		Kenya		South Africa		Uganda		Overall	
	Not Pregnant (N=4404)	Pregnant (N=82)	Not Pregnant (N=3736)	Pregnant (N=103)	Not Pregnant (N=3277)	Pregnant (N=103)	Not Pregnant (N=6036)	Pregnant (N=219)	Not Pregnant (N=17453)	Pregnant (N=507)
Participant Type										
Control	2237 (50.8%)	49 (59.8%)	1793 (48.0%)	63 (61.2%)	1729 (52.8%)	73 (70.9%)	3018 (50.0%)	131 (59.8%)	8777 (50.3%)	316 (62.3%)
Case	2167 (49.2%)	33 (40.2%)	1943 (52.0%)	40 (38.8%)	1548 (47.2%)	30 (29.1%)	3018 (50.0%)	88 (40.2%)	8676 (49.7%)	191 (37.7%)
Age										
Mean (SD)	36.6 (10.7)	32.1 (5.27)	36.7 (11.9)	29.7 (6.04)	40.6 (12.6)	29.1 (6.58)	36.8 (12.5)	29.9 (6.00)	37.4 (12.0)	30.0 (6.08)
Median [Min, Max]	36.0 [18.0, 78.0]	31.0 [19.0, 43.0]	35.0 [18.0, 77.0]	30.0 [18.0, 49.0]	40.0 [18.0, 81.0]	29.0 [18.0, 44.0]	35.0 [18.0, 89.0]	30.0 [18.0, 48.0]	36.0 [18.0, 89.0]	30.0 [18.0, 49.0]
Marital Status										
Married/Life partner	1446 (32.8%)	79 (96.3%)	1582 (42.3%)	84 (81.6%)	904 (27.6%)	47 (45.6%)	2326 (38.5%)	172 (78.5%)	6258 (35.9%)	382 (75.3%)
Divorced/Separated/Widowed	1105 (25.1%)	1 (1.2%)	940 (25.2%)	6 (5.8%)	617 (18.8%)	4 (3.9%)	1900 (31.5%)	18 (8.2%)	4562 (26.1%)	29 (5.7%)
Never been married	1853 (42.1%)	2 (2.4%)	1214 (32.5%)	13 (12.6%)	1756 (53.6%)	52 (50.5%)	1810 (30.0%)	29 (13.2%)	6633 (38.0%)	96 (18.9%)
Education										
No education	294 (6.7%)	9 (11.0%)	74 (2.0%)	1 (1.0%)	19 (0.6%)	0 (0%)	385 (6.4%)	2 (0.9%)	772 (4.4%)	12 (2.4%)
Primary school	1267 (28.8%)	21 (25.6%)	1251 (33.5%)	29 (28.2%)	346 (10.6%)	7 (6.8%)	2384 (39.5%)	84 (38.4%)	5248 (30.1%)	141 (27.8%)
Secondary school	1636 (37.1%)	26 (31.7%)	1112 (29.8%)	28 (27.2%)	2180 (66.5%)	81 (78.6%)	2168 (35.9%)	94 (42.9%)	7096 (40.7%)	229 (45.2%)
College	1207 (27.4%)	26 (31.7%)	1299 (34.8%)	45 (43.7%)	730 (22.3%)	15 (14.6%)	1096 (18.2%)	39 (17.8%)	4332 (24.8%)	125 (24.7%)
Psychosis Diagnosis (Cases)										
Bipolar/Mania NOS	701 (15.9%)	14 (17.1%)	847 (22.7%)	23 (22.3%)	735 (22.4%)	13 (12.6%)	1697 (28.1%)	48 (21.9%)	3980 (22.8%)	98 (19.3%)
Schizophrenia	1466 (33.3%)	19 (23.2%)	1096 (29.3%)	17 (16.5%)	813 (24.8%)	17 (16.5%)	1321 (21.9%)	40 (18.3%)	4696 (26.9%)	93 (18.3%)
K10 Total (Controls)										
Mean (SD)	11.5 (3.09)	10.8 (2.15)	12.8 (3.76)	13.6 (4.27)	15.1 (5.85)	14.3 (4.97)	12.2 (3.90)	12.4 (4.04)	12.7 (4.34)	12.8 (4.24)
Median [Min, Max]	10.0 [10.0, 41.0]	10.0 [10.0, 22.0]	12.0 [10.0, 42.0]	12.0 [10.0, 29.0]	13.0 [10.0, 47.0]	13.0 [10.0, 33.0]	10.0 [10.0, 50.0]	11.0 [10.0, 41.0]	11.0 [10.0, 50.0]	11.0 [10.0, 41.0]
Height(cm)										
Mean (SD)	159 (6.40)	159 (5.22)	163 (6.50)	162 (6.07)	161 (6.59)	159 (5.72)	160 (6.44)	160 (6.39)	160 (6.66)	160 (6.10)
Median [Min, Max]	158 [134, 187]	159 [148, 170]	163 [136, 185]	162 [146, 180]	160 [133, 193]	160 [147, 173]	160 [133, 187]	160 [141, 179]	160 [133, 193]	160 [141, 180]
Weight(kg)										
Mean (SD)	63.1 (12.8)	64.6 (13.0)	66.6 (13.4)	66.3 (13.1)	80.1 (20.7)	73.7 (17.1)	62.8 (13.9)	66.5 (14.5)	66.9 (16.4)	67.6 (14.9)
Median [Min, Max]	61.0 [35.0, 120]	64.5 [40.0, 100]	65.0 [35.2, 137]	64.0 [44.6, 111]	78.0 [35.0, 180]	72.0 [43.3, 122]	60.0 [31.0, 150]	64.2 [39.0, 125]	64.0 [31.0, 180]	65.0 [39.0, 125]
BMI										
Mean (SD)	25.1 (4.90)	25.6 (4.75)	25.0 (4.63)	25.3 (4.79)	31.1 (7.72)	29.1 (6.51)	24.6 (5.26)	25.9 (5.22)	26.0 (6.11)	26.4 (5.52)
Median [Min, Max]	24.3 [12.0, 47.1]	25.4 [16.7, 36.8]	24.4 [14.2, 50.8]	24.5 [16.3, 44.9]	30.3 [14.0, 69.4]	27.8 [16.9, 45.1]	23.5 [12.8, 52.2]	25.1 [16.5, 46.4]	24.8 [12.0, 69.4]	25.4 [16.3, 46.4]

Reference groups: Not Partnered, College, and Ethiopia

Prevalence

Table 3 depicts the prevalence of psychosis diagnosis within the study population, stratified by study site and pregnancy status.

	Table 3: Prevalence of Psychosis Cases among Pregnant and Non-Pregnant Participants in the NeuroGAP-Psychosis Parent Study									
	Ethiopia		Kenya		South Africa		Uganda		Overall	
	Not Pregnant (N = 4404)	Pregnant (N = 82)	Not Pregnant (N = 3736)	Pregnant (N = 103)	Not Pregnant (N = 3277)	Pregnant (N = 103)	Not Pregnant (N = 6036)	Pregnant (N = 219)	Not Pregnant (N = 17,453)	Pregnant (N = 507)
Bipolar/Mania NOS	701 (15.9%)	14 (17.1%)	847 (22.7%)	23 (22.3%)	735 (22.4%)	13 (12.6%)	1697 (28.1%)	48 (21.9%)	3980 (22.8%)	98 (19.3%)
Schizophrenia	1466 (33.3%)	19 (23.2%)	1096 (29.3%)	17 (16.5%)	813 (24.8%)	17 (16.5%)	1321 (21.9%)	40 (18.3%)	4696 (26.9%)	93 (18.3%)
Overall	2167 (49.2%)	33 (40.2%)	1943 (52.0%)	40 (38.8%)	1548 (47.2%)	30 (29.1%)	3018 (50.0%)	88 (40.2%)	8676 (49.7%)	191 (37.7%)

In Ethiopia, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 40.2% and 49.2% respectively. Schizophrenia diagnosis ranged from 23.3% to 33.3% and bipolar/mania diagnosis from 15.9% to 17.1%.

In Kenya, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 38.8% and 52.0% respectively. Schizophrenia diagnosis ranged from 16.5% to 29.3% and bipolar/mania diagnosis from 22.3% to 22.7%.

In South Africa, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 29.1% and 47.2% respectively. Schizophrenia diagnosis ranged from 16.5% to 24.8% and bipolar/mania diagnosis from 12.6% to 22.4%.

In Uganda, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 40.2% and 50.0% respectively. Schizophrenia diagnosis ranged from 18.3% to 21.9% and bipolar/mania diagnosis from 21.9% to 28.1%.

Collectively, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 37.7% and 49.7% respectively. Schizophrenia diagnosis ranged from 18.3% to 26.9% and bipolar/mania diagnosis from 19.3% to 22.8%.

Statistical Analysis

Table 4 displays the three logistic models fitted to assess the association between pregnancy and psychosis in the NeuroGAP-Psychosis study population.

Table 4: Logistic Regressions Assessing the Association between Pregnancy and Psychosis

	Pregnant (Model 1)			**Non-Pregnant (Model 2)**			**Psychosis (Model 3)**		
Predictors	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*
Intercept	0.31	0.09 – 1.04	0.059	0.66	0.58 – 0.74	**<0.001**	0.12	0.06 – 0.24	**<0.001**
Age	1.04	1.01 – 1.07	**0.017**	1.01	1.00 – 1.01	**<0.001**	0.92	0.90 – 0.93	**<0.001**
Partnered	0.40	0.25 – 0.63	**<0.001**	0.49	0.46 – 0.52	**<0.001**	7.97	5.76 – 11.16	**<0.001**
Primary School or Below	1.76	1.05 – 3.00	**0.034**	1.87	1.72 – 2.04	**<0.001**	0.97	0.64 – 1.50	0.886
Secondary School	2.00	1.21 – 3.37	**0.008**	1.66	1.53 – 1.79	**<0.001**	1.16	0.79 – 1.75	0.456
Kenya	0.96	0.52 – 1.79	0.904	1.25	1.14 – 1.37	**<0.001**	0.94	0.59 – 1.52	0.805
South Africa	0.35	0.17 – 0.71	**0.004**	0.87	0.79 – 0.96	**0.005**	1.83	1.08 – 3.10	**0.023**
Uganda	0.83	0.49 – 1.44	0.510	1.02	0.94 – 1.10	0.714	1.37	0.91 – 2.09	0.139
Observations	507			17453			8867		
R^2 Tjur	0.060			0.041			0.040		

*Reference Groups: College, Not Partnered, and Ethiopia

Pregnant women who were partnered were 60% less likely (OR 0.4; 95% CI: 0.25-0.63) to experience MHP compared to pregnant women who were single/divorce/widowed (Table 3). Non-pregnant women who were partnered were 51% less likely (OR 0.49, 95% CI 0.46-0.52) to experience MHP compared to pregnant women who were single/divorce/widowed (Table 4). The psychosis model shows that pregnant women with psychosis who are unpartnered are at 7.97 times higher odds of having a MHP compared to unpartnered pregnant women with psychosis.

Compared to pregnant women with a college level education, pregnant women with primary or below (OR 1.76, 95% CI 1.05-3.00) or secondary school education (OR 2.00, 95% CI 1.21-3.37) were more likely to experience MHP. This was also found among non-pregnant women. Non-pregnant women with primary or below (OR 1.87, 95% CI 1.72-2.04) or secondary school education (OR 1.66, 95% CI 1.53-1.79) were more likely to experience MHP compared to non-pregnant women with a college level education.

For study countries, the odds of psychosis among pregnant women living in South Africa is 0.35 times the odds of MHP among pregnant women living in Ethiopia in the Pregnant model. Though the Non-Pregnant model had a similar odds ratio among non-pregnant women living in South Africa (OR 0.87, 95% CI 0.79-0.96), the Psychosis model showed a disparate association among pregnant women with a MHP diagnosis living in South Africa (OR 1.83, 95% CI 1.08-3.10). Being non-pregnant with a MHP diagnosis living in Kenya displayed a disparate association as well compared to non-pregnant with a MHP diagnosis living in Ethiopia (OR 1.25, 95% CI 1.14-1.37).

Discussion/Conclusion

Our study provides novel insight into the prevalence of mental health disorders with psychosis in Pregnant & Non-Pregnant women in Sub-Saharan Africa. This is critical global health issue that is poorly understood yet impacts 37.7% of pregnant and 49.7% of non-pregnant women in the NeuroGAP-Psychosis study population. In this study, women with secondary education level or less, regardless of their pregnancy status or study country, were associated with MHP. Partnered women are also at a lower risk of psychosis compared to single, widowed, or divorced women. Though there is a lack of literature in this specific research area, behavioral science research has

indicated that this could be due to the built-in support system that marriage or having a life partner can provide (Harandi et al., 2017). Among all study sites, South African participants seem to also be at a higher risk of psychosis compared to Ethiopia, Kenya, and Uganda. Across all study sites, the prevalence of overall psychosis diagnosis among pregnant and non-pregnant women is 37.7% and 49.7% respectively. Schizophrenia and bipolar diagnosis ranged from 18.3% to 26.9%. As a cross-sectional study, this paper was able to determine potential descriptive associations between pregnancy and psychosis. Due to the nature of this study, we were unable to establish a distinctive causal link between pregnancy, psychosis, and covariates. Even so, it is important to note that psychosis may have an effect on participants on meaningful development milestones, such as higher education and marriage, but the complexity of this bi-directional relationship indicates the need for these factors to be taken into consideration in future lines of research (Andreu-Bernabeu et al., 2023; White et al., 2021).

Though previous studies have attempted to establish prevalence for mental health disorders in pregnant women, many of them did not assess psychosis (Fisher et al., 2012; Sawyer et al., 2010). Studies that do examine the prevalence of psychosis among pregnant women in Africa tend to be country or region specific, therefore not being generalized to other African contexts. Even so, a cross-sectional study conducted by Adjorlolo et al. (2022) to determine the prevalence of psychotic-like experiences among pregnant women in Ghana. As mentioned in the literature review, 702 pregnant women that were not diagnosed with a mental disorder were included in the study and the survey indicated that 27.3% of participants were at moderate risk for psychosis while 18.5% of participants were at high risk for psychosis. This study did not assess participants with a clinician-confirmed diagnosis of psychosis, but the prevalence report by Adjorlolo et al. (2022) bears some similarities to some of the prevalence rates in this paper.

Though this paper did not look at the severity of psychosis disorders among NeuroGAP-Psychosis participants, it did determine the overall prevalence of bipolar/mania diagnosis and schizophrenia diagnosis among non-pregnant women to be 22.8% and 26.9% respectively and among pregnant women to be 19.3% and 18.3% respectively across all study sites. These results cannot make any claims with certainty due to the objectives of the NeuroGAP-Psychosis study, the limitations of the study design, and the inability to generalize these findings to the greater population within these countries and to other African countries. Even so, this paper highlights that there is reason to believe that psychosis could pose a risk during pregnancy and further research is needed to determine if this potential association is significant.

This paper provides evidence to suggest the effect that socioeconomic factors can have on health outcomes for this population. In our study, low maternal education was associated with increased risk of psychosis across all study countries. Based on the available literature on perinatal mental health disorders, socioeconomic factors, such as low educational levels, is a known risk factor for this population (Adjorlolo et al., 2022; Fisher et al., 2012; Ng'oma et al., 2020; Paschetta et al., 2014; Patel et al., 2006; Risal, 2011; Sawyer et al., 2010). Unfortunately, limited data was collected during the NeuroGAP-Psychosis study to indicate the socioeconomic status of participants. Other socioeconomic factors, such as income, employment status, housing insecurity, food security, and access to healthcare systems, would serve as insightful indicators for future research to help better understand this population. Optimal levels for each socioeconomic factor are crucial for all individuals, especially for pregnant women. Though the literature concerning psychosis and pregnancy is limited, Fisher et al. (2012) determined that common perinatal mental disorders were more prevalent among women with lower socioeconomic status, gender-based risk or a history of psychiatric conditions (Fisher et al.,

2012). This is also evident in this study. Across all logistic models, most indicated a disparate association between primary school or below (Pregnant OR 1.76, 95% CI 1.05-3.00; Non-Pregnant OR 1.87, 95% CI 1.72-2.04), secondary school (Pregnant OR 2.00, 95% CI 1.21-3.37; Non-Pregnant OR 1.66, 95% CI 1.53-1.79; Psychosis OR 1.16, 95% CI 0.79-1.75), and psychosis when using college education level as a reference group. The odds of psychosis among pregnant women with a MHP diagnosis and primary school education or below is 0.97 times the odds of psychosis among non-pregnant women with a MHP diagnosis and primary school education or below. This result is peculiar due to the known link between health and education (Kruk et al., 2018).

Access to healthcare is a critical factor to consider when analyzing this data. Although the NeuroGAP-Psychosis data does not have any specific variables that indicate access to healthcare, the participants were selected from hospital sites in each study country. This means that the data collected is not generalizable and can only be applied to patients from these specific hospitals. The data also does not reveal the quality of care, which can also contribute to participants' current health conditions. Each country included in this study has their own healthcare system with their own unique challenges.

Over the past few decades, Ethiopia has made great progress in implementing more modern medicine practices in their healthcare system. Despite the improved access to healthcare within the country through the introduction of health extension plans by the government, accessibility is limited (Tiruneh et al., 2020). Ethiopia is still experiencing a shortage of hospitals and healthcare workers. As for Kenya, the country is working towards establishing universal healthcare. Though some progress has been made, funding continues to be an issue as many Kenyans still struggle to afford out-of-pocket healthcare costs (Moses et al., 2021). Uganda’s

health policies and plans have allowed the country to experience steady progress in improving access and use of healthcare services (Malish, 2017). However, the quality of care and the availability of resources are also a persisting issue. Though the implementation of decentralized healthcare policy was intended to fix this challenge, it has not improved public health services, including the integration of mental health services (Malish, 2017; Wakida et al., 2019). In South Africa, the government has been implementing a variety of policies and strategies to improve public health services. Despite their efforts, the healthcare system in South Africa is still falling short. Some of the major challenges within their public health system are financial problems, staff shortages, and the fragmentation of services (Malakoane et al., 2020). Efforts are being made to improve the integration of healthcare services and other deficiencies affecting health outcomes (Malakoane et al., 2020). Though significant progress has been made in all study countries, the challenges that they each face still have a profound effect on their people, including pregnant women and individuals with MHP.

Limitations

Though the NeuroGAP-Psychosis study was one of the first studies in its field to include a wide range of human genetic diversity, it is important to note the limitations that arise from using this data for this paper. First, this data was not collected with pregnancy in mind. The data collected in this study that indicated which participants were pregnant was self-reported and the NeuroGAP-Psychosis study did not provide any other methods to confirm a participant's pregnancy status. This means some participants may have been pregnant at the time of data collection and did not know it, or some participants may have stated they were pregnant when they were not. Individuals with psychosis have been known to experience delusions that have led

them to believe they are pregnant when they are not (Bera & Sarkar, 2015). Since the NeuroGAP-Psychosis study did not conduct any additional tests to confirm pregnancy, we cannot verify participants' pregnancy status. Other pregnancy factors were also not considered when collecting the data, such as: parity, nutritional status, access to perinatal care. It would also be important to know if participants with a clinician-confirmed diagnosis maintained their treatment plan throughout their pregnancy. Though the NeuroGAP-Psychosis study did collect data on the psychiatric medications a participant was using, the study does not record the start or the duration of the treatment plan.

Another limitation is that some of the controls in this study may have psychosis. As previously mentioned, cases in the NeuroGAP-Psychosis study were defined as participants with a clinician-confirmed diagnosis of schizophrenia, bipolar, or other present forms of psychosis and controls were defined as participants that did not have a clinician-confirmed diagnosis. This means if a participant did have psychosis but did not have a clinician referral or medical record review to verify their condition, then they were included in the study as a control, a participant that does not have any psychosis disorders. This causes misclassification bias and can affect the odds ratios of this study, resulting in a misinterpretation of the potential associations between pregnancy and psychosis.

Lastly the current data provided a limited number of variables that could provide insight on the socioeconomic status of the study participants. Socioeconomic status, as previously discussed, is important to public health research. It is a key component in establishing social determinants to health and exposing underlying issues in negative health outcomes, including those associated with psychosis and pregnancy. These intersections are critical and need to be acknowledged. This also goes for potential risk factors. In the literature, there are many risk

factors for perinatal mental disorders that were not included in this study: unfavorable obstetric/neonatal/pregnancy outcomes, intimate partner violence, history of physical/sexual abuse and others (Adjorlolo et al., 2022; Fisher et al., 2012; Ng'oma et al., 2020; Paschetta et al., 2014; Sawyer et al., 2010). Future research should consider collected data based on these factors as well.

Implications/Recommendations

Using the NeuroGAP-Psychosis data was only the first step in assessing the prevalence of psychosis disorders in pregnant populations in Africa and identifying potential covariates that are associated with pregnancy and psychosis. Though this study provided insight, more research must be conducted with the population of interest in mind to establish any conclusive results. One way to approach this would be to conduct a longitudinal study with NeuroGAP-Psychosis participants. By following up with this population, researchers can build on the data and the relationships from the NeuroGAP-Psychosis study. Data collection tools can include variables that address socioeconomic status and pregnancy factors to better understand our subpopulation of interest. A mixed-method approach can also be incorporated to supplement the use of qualitative research methodology. In-depth interviewers with study participants, their loved ones, and healthcare providers can provide insight on the cultural and social factors that can affect psychosis and pregnancy and can inform the results obtained in the quantitative analysis. Pregnancy is a vulnerable period for women of reproductive age and their health. By conducting more research on mental health and pregnant women, we can better inform care for this population and improve health outcomes for both women and their children globally.

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