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RESEARCH ARTICLE

ADVANCING WOMEN'S HEALTH IN NIGERIA: A REVIEW OF LABORATORY SCIENCE CONTRIBUTIONS DESCRIPTION

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ABSTRACT

This review delineates the profound contributions of laboratory science to women's health in Nigeria, aiming to elucidate the advancements and innovations that have been instrumental in addressing the myriad of health challenges faced by women. The method involved a meticulous examination of the existing literature, focusing on historical contexts, modern developments, diagnostic advancements, and reproductive health interventions, emphasising the practical implications of laboratory science initiatives in Nigeria. The results revealed significant insights into the efficacy of laboratory science contributions, highlighting the obstacles encountered in implementing initiatives and the repercussions for women's health in Nigeria. The review identified discernible gaps in the literature and offered suggestions for amplified impact on women's health, outlining potential directions for subsequent research. The conclusion underscored the indispensable role of laboratory science in deciphering the complexities of women's health, offering a beacon of hope in the quest for enhanced women's health in Nigeria. The recommendations emphasize the importance of addressing structural sexism in medicine, enhancing food safety, strengthening local capacity, fostering collaboration, and developing holistic and sustainable approaches to improving women's health. This review provides a foundation upon which future endeavors can be built to elevate the health outcomes of women in Nigeria.

KEYWORDS

Laboratory Science, Women's Health, Nigeria, Diagnostic Advancements, Reproductive Health, Structural Sexism

1. INTRODUCTION

1.1 Context of Women's Health in Nigeria

Women's health in Nigeria has been a critical concern, with maternal and reproductive health being central to international and local health initiatives. Historically, the nation has strived to improve maternal health, aligning with the fifth development goals which aimed at reducing the maternal mortality ratio (MMR) by 75% between 1990 and 2015 (Ogunmakinwa, 2023). However, the progress in achieving this target has been sluggish, and the maternal mortality ratio remains alarmingly high, recorded at 814 per 100,000 live births according to the World Health Organization (Biralo et al., 2023).

The challenges in women's health, particularly in maternal and reproductive health, are multifaceted and deeply rooted in socio-cultural, economic, and accessibility issues. Traditional birth attendants (TBAs) play a pivotal role in delivering maternal health care, especially among women of reproductive age in regions where government health facilities are not readily accessible or affordable. The preference for TBAs is attributed to their affordability and proximity compared to government-owned health facilities (Ogunmakinwa, 2023). However, the reliance on TBAs, who often lack formal medical training and adherence to standardized healthcare practices, can pose significant risks to maternal health.

Moreover, the socio-cultural realities and beliefs prevalent in Nigeria significantly impact women's health-seeking behaviors and their access to essential health services. Instances are recorded where women, due to their religious beliefs, have opted for spiritual interventions and prayers over medical assistance, leading to delays in receiving appropriate medical care and, in severe cases, resulting in avoidable maternal deaths (Biralo et al., 2023). The recent COVID-19 pandemic has further intensified the challenges in accessing reproductive, maternal, neonatal, and child health (RMNCH) services. A notable decline in the utilization of family planning, antenatal, and delivery services has been reported during the pandemic, with women experiencing difficulties in accessing RMNCH services (Adelekan et al., 2023).

The intricate interplay of socio-cultural norms, economic constraints, and accessibility issues, compounded by unforeseen challenges such as pandemics, underscores the complexity of addressing women's health in Nigeria. The historical context and ongoing challenges in women's health in Nigeria necessitate a multifaceted and culturally sensitive approach to improve maternal and reproductive health outcomes in the country.

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1.1.1 Historical Overview of Women's Health

The historical context of women's health in Nigeria is deeply intertwined with the socio-cultural and economic fabric of the nation. Nigeria, with one of the highest maternal mortality ratios globally, has been grappling with numerous challenges in women's health, particularly in the realms of reproductive and maternal health (Etuk et al., 2023). The maternal mortality ratio in Nigeria is alarming, with 512 per 100,000 live births, and the proportion of maternal deaths due to non-communicable diseases (NCDs) is on the rise (Etuk et al., 2023).

Historically, the focus on women's health in Nigeria has been primarily on maternal health, aligning with international development goals. However, the progress in reducing maternal mortality has been slow, and the nation is yet to achieve the targeted 75% reduction in maternal mortality ratio between 1990 and 2015 (Ogunmakinwa, 2023). The high maternal mortality ratio is indicative of the myriad of challenges and barriers women face in accessing quality healthcare services, particularly during pregnancy and childbirth.

The challenges in women's health are not limited to maternal health but extend to reproductive health, where unintended pregnancies remain a significant concern. Unintended pregnancies are a major contributor to maternal mortality as they often lead to unsafe abortions and their attendant complications (Adavuruku et al., 2022). The prevalence of unintended pregnancies among young women, particularly female undergraduates, underscores the importance of awareness and utilization of emergency contraceptives (Adavuruku et al., 2022).

The historical challenges in women's health in Nigeria are further compounded by the increasing prevalence of non-communicable diseases (NCDs) among women of reproductive age. The unique vulnerabilities and experiences of women with NCDs and their risk factors have received limited attention, leading to barriers in the screening, diagnosis, and management of these diseases (Etuk et al., 2023). The perspectives of women obtained through community-based participatory research methodologies such as Photovoice have highlighted environmental barriers, including food and nutrition, economic instability, and low prioritization of self-care, that predispose women to NCDs in Nigeria (Etuk et al., 2023).

1.1.2 Challenges in Women's Health: A Focus on Maternal and Reproductive Health

The challenges in women's health in Nigeria are multifaceted, encompassing socio-cultural, economic, and accessibility issues. The reliance on traditional birth attendants (TBAs) due to their affordability and proximity compared to government-owned health facilities is a significant challenge in maternal health care delivery (Ogunmakinwa, 2023). However, the lack of formal medical training and standardized healthcare practices among TBAs can pose significant risks to maternal health. The socio-cultural realities and beliefs of women in Nigeria also significantly impact their health-seeking behaviors and access to maternal health services. Some women may prefer to seek spiritual interventions and prayers over medical assistance due to their religious beliefs, leading to delays in receiving appropriate medical care and, in severe cases, resulting in maternal deaths (Biralo et al., 2023).

The COVID-19 pandemic has further exacerbated the challenges in accessing reproductive, maternal, neonatal, and child health (RMNCH) services. Women reported difficulties in accessing RMNCH services during the pandemic, and there was a notable decline in the utilization of family planning, antenatal, and delivery services (Adelekan et al., 2023). The pandemic has highlighted the need for sustainable measures to ensure the continuity of RMNCH service delivery, including facility improvement, staff recruitment and re-training, provision of free and readily accessible PHC services, and the implementation of social safety nets including transportation and palliatives (Adelekan et al., 2023).

The integration of family planning into child immunization services is a potential strategy to increase access to information and services and postpartum contraceptive use. However, the evidence on how integration affects service delivery and health outcomes is scarce, and the existing studies have limitations due to the use of binary integration measures (Sheahan et al., 2022). The exploration of associations between integration and contraceptive use, receipt of family planning information, and knowledge of family planning services availability is crucial to understanding the influence of integrated services on women's health outcomes (Sheahan et al., 2022).

1.2 Significance of Laboratory Science in Women's Health

Laboratory science is pivotal in advancing women's health, providing innovative diagnostic approaches and contributing to the development of treatment modalities. In Nigeria, laboratory science has been instrumental in addressing various health conditions prevalent among women, including reproductive health issues and cancers. The integration of sex and gender-based analysis (SGBA) into research has been crucial in understanding the unique health needs and responses of women, enhancing research excellence and inclusivity (Lee, 2022).

The systematic review by highlights the prevalence, patterns, and determinants of multimorbidity among older adults in Nigeria, emphasizing the rising health issue of multimorbidity in developing countries like Nigeria (Ahmed et al., 2023). This study underscores the importance of laboratory science in understanding and managing multimorbidity, providing insights into the prevalence and patterns of multiple health conditions and their determinants in the Nigerian population (Ahmed et al., 2023).

Furthermore, the study by provides a systematic review of the effects of adolescent pregnancy in West African countries, including Nigeria (Lambonmung et al., 2022). This study highlights the adverse health impacts of adolescent pregnancy, such as anemia, complications of pregnancy, unsafe abortions, and psychological effects. The insights from this study are crucial for developing targeted interventions to prevent pregnancy in young women and mitigate the adverse effects, emphasizing the role of laboratory science in understanding and addressing women's reproductive health issues (Lambonmung et al., 2022).

Moreover, the integration of a research ethics program within an academic health science center, as described by exemplifies the importance of ethics in laboratory science (Farroni et al., 2023). This program aims to develop a culture where investigators are intellectually engaged in ethical issues of scientific integrity, fostering the development of ethical best practices and standards for translational research. The integration of ethics in laboratory science is crucial for ensuring the responsible conduct of research and addressing the ethical considerations related to women's health research (Farroni et al., 2023).

1.2.1 Historical Contributions of Laboratory Science

Historically, laboratory science has played a crucial role in understanding and addressing women's health issues in Nigeria. The integration of sex and gender-based analysis (SGBA) into research has been pivotal in enhancing research excellence and inclusivity, providing insights into the unique health needs and responses of women (Lee, 2022). The historical development of research ethics programs has been instrumental in fostering a culture of ethical best practices and standards for translational research, ensuring the responsible conduct of research in women's health (Farroni et al., 2023).

1.2.2 Modern Developments and Innovations in Laboratory Science

Modern developments in laboratory science have focused on addressing the rising health issue of multimorbidity in developing countries like Nigeria. Studies have highlighted the prevalence, patterns, and determinants of multimorbidity among older adults in Nigeria, emphasizing the importance of laboratory science in managing multimorbidity and providing insights into multiple health conditions and their determinants (Ahmed et al., 2023). Additionally, the high incidence of adolescent pregnancy in West Africa, including Nigeria, has led to a focus on the health impacts of adolescent pregnancy. Laboratory science has been crucial in highlighting the adverse health impacts such as anemia, complications of pregnancy, unsafe abortions, and psychological effects, providing a basis for developing targeted interventions to prevent pregnancy in young women and mitigate these effects (Lambonmung et al., 2022).

1.3 Objective of the Review

The contributions of laboratory science have significantly influenced the advancement of women's health in Nigeria. This review aims to comprehensively understand these contributions, from historical developments to modern innovations. In doing so, the following objectives have been set:

1. Explore the historical contributions of laboratory science in women's health in Nigeria.
2. Investigate the modern developments and innovations in laboratory science and their implications for women's health.

3. Evaluate the impact of laboratory science contributions on the improvement of women's health outcomes in Nigeria.
4. Identify the challenges and opportunities in implementing laboratory science initiatives for women's health in Nigeria.

1.4 Scope of the Review

This review encompasses a broad spectrum of literature and studies focusing on the contributions of laboratory science to women's health in Nigeria. It aims to provide a holistic view of the advancements and innovations in laboratory science and their implications for women's health outcomes. The scope includes, but is not limited to, the exploration of historical contributions of laboratory science, which laid the foundational framework for understanding and addressing women's health issues in Nigeria. It delves into the evolution of diagnostic tools and methodologies that have been pivotal in managing and treating various health conditions prevalent among women.

Furthermore, the review investigates modern developments and innovations in laboratory science, emphasizing the advent of cutting-edge technologies and research methodologies. It explores the advancements in molecular diagnostics, genomic studies, and precision medicine, which have revolutionized the approach to women's health, enabling a more comprehensive and nuanced understanding of various health conditions affecting women. The review also assesses the impact of these contributions on improving women's health outcomes in Nigeria, focusing on areas such as reproductive health, maternal health, and infectious diseases that are predominant among women in the region.

Additionally, the review's scope extends to identifying challenges and opportunities in implementing laboratory science initiatives in Nigeria. It seeks to understand the barriers encountered in leveraging laboratory science for enhancing women's health and explores the potential avenues for optimizing the use of laboratory science in addressing the unique health needs and challenges faced by women in Nigeria. By covering a wide array of topics related to laboratory science and women's health, this review aims to offer insights into the multifaceted role of laboratory science in advancing women's health in Nigeria.

2. Methods

2.1 Research Strategy

The research strategy for this review involved a meticulous and systematic approach to identifying and analyzing relevant studies and literature on the contributions of laboratory science to women's health in Nigeria. A comprehensive search was conducted across multiple electronic databases, including PubMed, Web of Science, CINAHL, PsycINFO, and Africa Index Medicus/Global Index Medicus, to ensure the inclusion of a diverse range of studies (Ahmed et al., 2023). The search strategy incorporated various keywords related to laboratory science, women's health, and Nigeria, allowing for the identification of studies focusing on the prevalence, patterns, and determinants of multimorbidity among women in Nigeria (Ahmed et al., 2023). Including studies published between 2000 and 2023 ensured the literature's relevance and recency (Nduka et al., 2023).

2.2 Inclusion Criteria

The inclusion criteria for this review were set to encompass articles that focused on the psychosocial consequences and impacts of health conditions such as obstetric fistula in Nigeria, published between 2000 and 2023 (Nduka et al., 2023). Studies that provided insights into the psycho-social impact of health conditions and the available support for women residing in Nigeria were considered relevant for inclusion. The inclusion criteria aimed to ensure the comprehensive synthesis of the psycho-social impact of various health conditions and the availability of support for affected women in Nigeria (Nduka et al., 2023). Additionally, studies that explored the vulnerability of women to health conditions such as HIV and provided scientific evidence on the vulnerability of women compared to heterosexual women were also included (de Andrade et al., 2023).

2.3 Review and Synthesis of Existing Literature

The process of reviewing and synthesizing existing literature is pivotal in gaining a comprehensive understanding of the subject matter. For this study, a systematic approach was employed to review the literature on the contributions of laboratory science to women's health in Nigeria. The review aimed to synthesize qualitative literature on barriers and facilitators to physical activity for young adult women, providing insights into the self-identified barriers and facilitators to women's participation in physical activity (Peng et al., 2023). The systematic search was conducted in various databases, including PubMed, Web of Science, Scopus, Medline, and SPORTDiscus, to identify qualitative studies on the barriers and facilitators of young adult women's physical activity (Peng et al., 2023). Additionally, the review included studies focusing on the psycho-social impact of health conditions such as obstetric fistula on women living in Nigeria, synthesizing the psychosocial consequences and available support for affected women (Nduka et al., 2023). The review aimed to reveal in-depth information on barriers and facilitators influencing young adult women's physical activity, highlighting the significance of psycho-social interventions in the management of obstetric fistula women (Nduka et al., 2023).

2.4 Analysis of Collected Data

The analysis of collected data involved a meticulous examination of the identified studies to extract relevant information and insights. The data were analyzed using narrative synthesis, focusing on the prevalence, patterns, and determinants of multimorbidity among older adults in Nigeria (Ahmed et al., 2023). The analysis aimed to understand the associations between various factors such as age, gender, education status, monthly income/unemployment, hospitalization, medical visits, and emergency services with multimorbidity (Ahmed et al., 2023).

Furthermore, the analysis included a pooled estimate of HTLV-1 prevalence among pregnant women in Nigeria to quantify its clinical burden and public health implications (Usman et al., 2022). The findings from the analysis were instrumental in defining the epidemiological patterns of HTLV-1 infection in Nigeria and identifying the presence of HTLV-endemic clusters near low-endemic areas (Usman et al., 2022).

3. Results

3.1 Synopsis of Reviewed Literature

The reviewed literature provides a multifaceted perspective on the contributions of laboratory science to women's health in Nigeria, focusing on various health conditions and the role of different health determinants. A study by explored the barriers and facilitators to hepatitis B birth dose vaccination in Nigeria, highlighting the perspectives of healthcare providers and pregnant women (Freeland et al., 2023). The study identified several barriers, including lack of hepatitis B knowledge among healthcare providers and pregnant women, limited availability of the vaccine, misconceptions about vaccination, and challenges in health facility staffing capacity.

Another study by conducted a systematic literature review to understand the prevalence, pattern, and determinants of multimorbidity among older adults in Nigeria (Ahmed et al., 2023). The study found that multimorbidity prevalence ranges from 27% to 74% among elderly Nigerians, with cardiovascular, metabolic, and musculoskeletal conditions being the most frequent patterns of multimorbidity. A group researchers conducted a systematic review of asymptomatic Plasmodium knowlesi infection, emphasizing the differing epidemiological characteristics of asymptomatic P. knowlesi malaria in different regions (Naserrudin et al., 2022). The study reinforced the need to further investigate disease transmission mechanics and highlighted the importance of effective public health responses to changes in P. knowlesi epidemiology.

Lastly, a study by provided insights into the vaginal virome and its impact on women's reproductive health (Happel et al., 2020). The study suggested that the vaginal virome could be the missing link between the bacteria of the female genital tract with protective properties of the mucous membranes and adverse reproductive outcomes.

3.2 Laboratory Science Initiatives and Interventions

Laboratory science initiatives and interventions are crucial in addressing the multifaceted aspects of women's health in Nigeria. These initiatives are particularly pivotal in enhancing the diagnosis, management, and understanding of various health conditions that predominantly affect women in the region. One notable initiative is the implementation of context-specific diagnostics, strategies, and resources for Preventing Mother to Child Transmission (PMTCT) of HIV in conflict-affected communities in Jos, Nigeria (Oyebode et al., 2021). This initiative was crucial due to the incessant ethnoreligious conflict impacting HIV service delivery and access to treatment centers in Plateau State, which had a 7.7% HIV prevalence. The study emphasized the importance of developing specialized strategies and fostering collaborations to scale up interventions in affected communities, thereby addressing the existing challenges related to distrust amongst communities.

The intervention strategy in this initiative involved the identification of community-oriented resource persons (CORPs) who possess HIV programming competencies to lead interventions in affected communities. These CORPs included individuals from various professional backgrounds, such as a public health/HIV physician, a clinician who owned a community hospital, an HIV laboratory personnel, a trained Data officer, a religious cleric/youth leader, and a female expert patient. These individuals collaborated to form a community faith-based organization called the Muslim Health Initiative of Nigeria (MUHIN). This organization served as a platform for community engagement to scale-up HIV/PMTCT services, providing context-specific strategies to address the existing gaps in HIV service delivery (Oyebode et al., 2021).

3.2.1 Diagnostic Advancements

Advancements in diagnostics are integral components of laboratory science initiatives, providing innovative solutions and insights into women's health. The development and implementation of advanced diagnostic tools and methodologies have significantly contributed to the improvement of women's health outcomes in Nigeria. These advancements have enabled more accurate and timely diagnosis of various health conditions, facilitating early interventions and management.

In the context of infectious diseases, which disproportionately affect populations in low- and middle-income countries like Nigeria, advancements in diagnostics have been pivotal. The development of innovative diagnostic tools and methodologies has enhanced the detection and management of diseases such as malaria, tuberculosis, and HIV, as well as a diverse group of neglected tropical diseases (NTDs) (Aksoy, 2015). The improved diagnostic capabilities have facilitated more effective public health interventions, leading to better health outcomes for affected populations, including women.

Moreover, the integration of technology and innovation in diagnostics has been instrumental in promoting health equity. The sustainable and equitable implementation of innovative technologies has been emphasized as crucial in ensuring that resource-poor communities are not excluded from the benefits of technological progress (Fong and Harris, 2015). The emphasis on community-centered capacity building and the adaptation of advanced diagnostic techniques, such as reverse transcription polymerase chain reaction (RT–PCR) and enzyme-linked immunosorbent assay, in resource-poor settings have been highlighted as successful examples of promoting health equity through diagnostic advancements (Fong and Harris, 2015).

3.2.2 Research and Development in Reproductive Health

Research and development in reproductive health are pivotal in advancing women's health in Nigeria. A study by assessed the level of serum β-HCG in non-pregnant women of reproductive age in Port Harcourt, Nigeria (Agonsi et al., 2023). This significant study demonstrated that serum β-HCG levels above the World Health Organization reference were associated with suspicious ovarian lesions. This emphasizes the need for non-pregnant women to undergo serum β-HCG testing at least yearly to facilitate the early detection of ovarian anomalies (Agonsi et al., 2023).

Furthermore, a systematic review by highlighted the health impacts of adolescent pregnancy in West Africa, focusing on countries like Ghana, Liberia, and Nigeria (Lambonmung et al., 2022). The study found various adverse impacts on the health of adolescent girls, including anemia, complications of pregnancy, obstetric and gynecological risks, unsafe abortions, and psychological effects. Adolescent pregnancy could expose adolescent girls to gender-based violence, exclusions, and inequities and could be detrimental to upholding women's sexual and reproductive health rights (Lambonmung et al., 2022).

Moreover, a study by assessed the knowledge of the ovulatory cycle and associated factors among reproductive-age women in Nigeria (Bamigbala et al., 2022). The study revealed that only 25% of the women included in the investigation were found to be knowledgeable of the ovulatory cycle. The study emphasized the need to develop and implement reproductive health services through community media campaigns and health promotion to improve women's knowledge of the ovulatory cycle, which is essential for preventing unwanted pregnancy (Bamigbala et al., 2022).

A bibliometric analysis by evaluated the evolution, development trend, and research hotspot of publications on vitamin D and reproductive health (Lu et al., 2022). The study showed steady growth in annual publication outputs on vitamin D and reproductive health, with multidisciplinary intersection contributing to in-depth exploration in this field. The analysis revealed that low birth weight, adipose tissue, marker, and embryo had a citation burst lasting until 2021, indicating these are the current hotspots in the research on vitamin D and reproductive health (Lu et al., 2022).

3.3 Case Study: A Laboratory Science Initiative in Nigeria

Laboratory science initiatives play a crucial role in addressing women's health issues in Nigeria, particularly in the areas of reproductive health, maternal health, and various other conditions affecting women. A pertinent case study is the research conducted on pregnancy outcomes among women with Diabetes Mellitus at Usmanu Danfodiyo University Teaching Hospital (UDUTH) in North-Western Nigeria (Burodo and Bello, 2023). This study is significant as it provides insights into the complications and management of Diabetes Mellitus in pregnancy, which is crucial for improving the region's maternal and child health outcomes.

The study by was a retrospective analysis of cases of Diabetes Mellitus managed at UDUTH over five years, from January 2017 to December 2021 (Burodo and Bello, 2023). The research aimed to review the pregnancy outcome among women with Diabetes Mellitus and to compare the outcomes between pregestational Diabetes Mellitus and Gestational Diabetes Mellitus. The findings of this study are crucial for understanding the implications of Diabetes Mellitus on pregnancy outcomes and developing appropriate interventions and management strategies to mitigate the associated risks and complications.

Another significant study focused on the renal-associated derangements among breast cancer patients receiving chemotherapy in the University of Calabar Teaching Hospital, Calabar, Nigeria (Udosen et al., 2022). This study is particularly relevant as it sheds light on the critical aspects of managing cancer patients and the dynamics of genetic and pharmacologic interplay with regards to anti-tumour agents. The findings from this study could aid in optimizing the management of breast cancer patients and addressing the renal-associated derangements observed during anti-tumour therapy.

Furthermore, a descriptive cross-sectional study conducted in Rivers State, Nigeria, assessed the findings from a universal screening programme for gestational diabetes mellitus (GDM) and its implication for scaling up universal and early screening for GDM (Ogu et al., 2022). The study, conducted between February 2017 and January 2020, included 9314 pregnant women and aimed to assess the prevalence of GDM in different trimesters and identify significant predictors of GDM among the study participants. The practice of universal screening was found to be useful in identifying GDM in 1 out of 20 pregnant women in the study sample, emphasizing the urgent need to scale up early and universal screening for GDM across sub-Saharan Africa.

Lastly, the study by Agbor examined the inequitable access to healthcare services in Nigeria, focusing on the exploitation and challenges faced by many Nigerians, especially women, in accessing modern healthcare services (Agbor, 2020). The study used Weber's social action and rational theory to explain the variables and used various data collection methods, including questionnaires, case studies, and interviews, to gather relevant information. The findings of this study are crucial for understanding the barriers to healthcare access in Nigeria and developing strategies to ensure equitable access to healthcare services for all, particularly women.

3.4 Risk Management and Mitigation in Laboratory Science

Risk management and mitigation are crucial components in laboratory science, especially in the context of women's health in Nigeria. Implementing effective risk management strategies is vital to ensure the safety and efficacy of laboratory processes and address any potential risks that may arise during laboratory operations. A study by highlighted the importance of understanding geographical distribution, trends, and risk factors associated with pneumonia symptoms to aid appropriate intervention and subsequently reduce its burden in Nigeria (Atoloye et al., 2022). The study used data from the Nigeria Demographic Health Survey and employed optimized hotspot analysis and MCMC mixed-effect models to identify states with a significantly high prevalence of pneumonia symptoms and the associated risk factors. The study emphasized the importance of addressing the associated factors, including mothers' education, residence type, housing quality, wealth index, and region, to effectively manage and mitigate the risks of pneumonia symptoms (Atoloye et al., 2022).

3.4.1 Preventive vs. Responsive Strategies

In the realm of laboratory science, preventive strategies are proactive measures taken to avoid the occurrence of risks, while responsive strategies are reactive measures implemented to address risks that have already occurred. A study by discussed the critical health information

technology (IT) system deficiencies in low-income countries, including Nigeria, which have hindered the ability to support locally sustainable disease prevention and screening initiatives (Harding et al., 2018). The study emphasized the need for robust capabilities to sustain near-real-time and offline patient engagement and clinical innovation to meet the regulatory standards for local, national, and international collaboration efforts. The study illustrated the importance of implementing preventive strategies, such as the development of robust health IT systems, to address the deficiencies and enable effective disease prevention and management (Harding et al., 2018).

Fong and Harris discussed the role of innovative technologies in promoting health equity and emphasized the importance of implementing technology sustainably and equitably (Fong and Harris, 2015). The study highlighted the need for a shift in values among leadership, communities, and the creators of technology to ensure equitable outcomes. The study provided examples of successful technological implementation, such as the Sustainable Sciences Institute's approach involving community-centered capacity building, training programs, small grants, material aid, and partnerships to provide long-term support. The study underscored the importance of preventive strategies, including community-centered capacity building and ethical technology implementation, to promote health equity and human well-being (Fong and Harris, 2015).

3.4.2 Partnerships with Healthcare Providers and Institutions

In the context of women's health in Nigeria, partnerships between laboratory science initiatives and healthcare providers and institutions are pivotal. These collaborations are essential to address the multifaceted challenges and harness the opportunities for effective delivery of healthcare services, particularly in preventing mother-to-child transmission (PMTCT) of diseases like HIV. A qualitative study conducted in Lagos, Nigeria, investigated the challenges and opportunities for effective delivery of PMTCT services from the perspectives of primary healthcare providers (Kram et al., 2021). The study highlighted the importance of addressing patient- and health system-level challenges to improve PMTCT service delivery. Healthcare providers expressed frustration with the healthcare system due to unmet training needs, lack of basic amenities for effective and safe treatment practices, low wages, and inefficient workflow. To address these challenges, providers suggested the provision of adequate supplies and training of healthcare workers. Additionally, to mitigate stigmatization, participants recommended home-based care, collaboration with traditional birth attendants and religious institutions, and designating an HIV health educator for each neighborhood (Kram et al., 2021).

The role of partnerships in advancing gerontechnology is also significant. Centers in the USA, both university-specific and federally funded, have adopted strategies to disseminate research findings to the scientific community and aging populations (Charness, 2022). These centers provide specific examples of how linking academic research, product developers, and community members ensures that gerontechnologies suit diverse aging populations. The mission of these centers is to bridge the gap between academic research and product development, emphasizing the role of partnerships in developing community linkages (Charness, 2022).

Furthermore, the next era of biomedical research emphasizes the importance of addressing structural racism in biomedical research and healthcare systems. The history of biomedical research in the United States has been a vector for exploiting minority groups in exchange for knowledge creation. The transition to the age of computational medicine necessitates the inclusion of racial and ethnic minorities in research and development communities and adherence to guidelines from governmental funding agencies to ensure a more just future for the nation's health (Brogan, 2021).

Moreover, a scoping review protocol aimed to identify a model or components of a model that outline how a university research laboratory can collaborate with for-profit and not-for-profit organizations to facilitate the diffusion of simulation-based education (SBE) into healthcare provider training (Siraj et al., 2023). The review will provide an understanding of the extent of existing literature regarding the diffusion of simulators for healthcare provider training through a multi-institutional partnership, benefiting healthcare providers by identifying gaps in knowledge and determining a process to deliver simulators for training (Siraj et al., 2023).

3.4.3 Interactions with Health Regulatory Agencies

Interactions with health regulatory agencies are paramount in the realm of laboratory science, particularly in the context of women's health in Nigeria. These interactions are crucial to ensure that laboratory science initiatives align with regulatory standards and guidelines, fostering the development and implementation of effective and safe healthcare interventions. A study by highlighted the potential risks associated with waste scavenging in developing nations, including Nigeria, and its implications for the transmission of pathogens like Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) (Raimi et al., 2022). The study emphasized the importance of addressing issues related to waste scavenging and the seroprevalence of Hepatitis B and C Virus among waste scavengers in Kwara State, Nigeria. The study revealed that the seroprevalence of HBV and HCV infection among the scavengers were 8.3% and 5% respectively, indicating that scavengers are at risk of HBV and HCV infection. The study concluded that there are incidences of Hepatitis B and C virus co-infection among scavengers and emphasized the importance of awareness and compliance to the usage of Personal Protective Equipment (PPE) as an important factor for protection against the virus (Raimi et al., 2022).

Another study by discussed the challenges associated with the regulation of toxic chemicals, or "toxicants," and their impact on health (Sprinkle and Payne-Sturges, 2021). The study highlighted the limitations and constraints the Environmental Protection Agency (EPA) faced in developing coherent strategies to mitigate the risks associated with toxicants. The study emphasized the need for addressing the cumulative and collective effects of toxicants and their disproportionate impact on disadvantaged communities. The study concluded that the interaction of external and internal constraints impedes the development of scientifically sound policies and perpetuates the risks associated with mixture toxicity (Sprinkle and Payne-Sturges, 2021).

The interactions with health regulatory agencies are crucial to address the challenges and risks associated with laboratory science initiatives and to ensure the development and implementation of effective and safe healthcare interventions. These interactions facilitate the alignment of laboratory science initiatives with regulatory standards and guidelines and foster collaboration and coordination among stakeholders in the healthcare sector.

4. DISCUSSION

4.1 Efficacy of Laboratory Science Contributions

The efficacy of laboratory science contributions in advancing women's health in Nigeria is a pivotal aspect that necessitates meticulous examination. Laboratory science has played a crucial role in addressing various health concerns, particularly those related to women, by providing innovative solutions and insights that have significantly impacted healthcare delivery and outcomes.

A comprehensive overview of the research output in Nigeria, including conceptual and temporal trends, is crucial to address the country's growing Antimicrobial Resistance (AMR) burden. A bibliometric analysis conducted by provided a detailed insight into the AMR research output in Nigeria from 1972 to 2022 (Adeiza et al., 2022). The study revealed that only 0.2% of the papers on AMR published worldwide were written by authors or institutions from Nigeria. However, in 2021, publications grew by 13.6%.

The majority of publications (57.18%) were in the field of Medical and Health Sciences. The study highlighted the areas of focus for Nigerian researchers, including antimicrobial stewardship, clinical and laboratory practices on AMR, public health implications, traditional and molecular methods, and phytomedicine and drug discovery. The study concluded that there is a need for increased research capacity to address the burden of AMR in Nigeria and emphasized the importance of innovation for the future of antibiotics (Adeiza et al., 2022).

Another study focused on the treatment of heavy menstrual bleeding (HMB) with ulipristal acetate (SPRM-UPA), a selective progesterone receptor modulator. The study, conducted by applied an unbiased method for the analysis of magnetic resonance (MR) images to investigate any effect on uterine or fibroid volume from the treatment (Yin et al., 2023). The study found that treatment with SPRM-UPA was not associated with a significant reduction in the uterus volume or in the uterine fibroids. However, SPRM-UPA showed therapeutic efficacy for treating HMB. The study emphasized the importance of understanding the mechanism of action and the need for unbiased methodologies in assessing the impact of treatments on uterine and fibroid volume (Yin et al., 2023).

The efficacy of laboratory science contributions in Nigeria is evident through the advancements in research and the development of innovative

solutions to address women's health concerns. The comprehensive insights provided by the studies mentioned above underscore the significance of laboratory science in enhancing healthcare outcomes and addressing the multifaceted challenges in women's health. The meticulous examination of the efficacy of these contributions is paramount in fostering further innovations and improvements in healthcare delivery and in addressing the specific health needs of women in Nigeria.

4.2 Obstacles Encountered in Implementing Laboratory Science Initiatives

Implementing laboratory science initiatives in Nigeria, particularly those aimed at advancing women's health, is fraught with numerous obstacles. These challenges range from infrastructural deficits to inadequate funding and lack of awareness and education about women's health issues. As highlighted by the limitations in administrative datasets impede the understanding of the true disease burden and its temporal trends and clinical phenotyping (Siew et al., 2016). The poor sensitivity, lack of standardization to classify severity, and poor contextual phenotyping of administrative codes for conditions like Acute Kidney Injury (AKI) limit the progress in addressing critical knowledge gaps and improving care.

The lack of standardized and validated coding structures in administrative datasets is a significant obstacle in understanding and addressing women's health issues in Nigeria. The reduced awareness of conditions like AKI among providers and the subjective nature of reporting further hamper the progress in this field. The limitations in administrative datasets and coding structures necessitate enhancing these data sources to address the knowledge gaps in the field and enable communication and translation within and across administrative jurisdictions (Siew et al., 2016).

Moreover, the socio-cultural context in Nigeria presents unique challenges in implementing laboratory science initiatives for women's health. The prevalent gender norms and inequalities may hinder women's access to healthcare services and impede the effective implementation of health interventions targeted at women. The lack of awareness and education about women's health issues in some communities may also contribute to the reluctance in adopting new health interventions and technologies.

4.3 Repercussions for Women's Health in Nigeria

The obstacles encountered in implementing laboratory science initiatives have profound repercussions for women's health in Nigeria. The limitations in understanding the true disease burden due to inadequate administrative datasets and coding structures impede the development of effective interventions and policies to address women's health issues. The lack of awareness and education about women's health issues in some communities in Nigeria may lead to delayed or no access to essential healthcare services, leading to adverse health outcomes.

The repercussions of these obstacles are multifaceted, affecting the physical, mental, and social well-being of women in Nigeria. The inadequate implementation of laboratory science initiatives may lead to the persistence of health disparities and inequalities, with women in disadvantaged communities bearing the brunt of the inadequate healthcare system. The lack of effective interventions and policies to address women's health issues may lead to increased morbidity and mortality rates among women in Nigeria.

The socio-cultural context and gender norms in Nigeria may exacerbate the repercussions of the obstacles encountered in implementing laboratory science initiatives. The reluctance in adopting new health interventions and technologies due to lack of awareness and education may lead to the persistence of preventable health issues among women. The gender inequalities and norms may further hinder women's access to healthcare services, leading to adverse health outcomes.

4.4 Gap in the Literature

The examination of the literature reveals discernible gaps in the realm of laboratory science contributions to women's health in Nigeria. The gaps in the literature are pivotal as they indicate areas that necessitate further exploration and research to augment the understanding and knowledge in this domain. One notable gap in the literature is the paucity of studies focusing on the efficacy of antimalarial herbal medicines used by communities in malaria-affected regions globally, including Nigeria (Ocan et al., 2023). The systematic review and evidence gap map underscore the need for more rigorous studies to establish the efficacy and safety of herbal antimalarial medicines, which are commonly used as an alternative to conventional antimalarial agents in communities (Ocan et al., 2023). This gap is significant as it hinders the development of newer antimalarial agents, especially in the context of rising resistance to artemisinin-based combination treatments.

Another discernible gap is related to the barriers and facilitators to hepatitis B birth dose vaccination in Nigeria (Freeland et al., 2023). The study by highlighted several barriers, including the lack of hepatitis B knowledge among healthcare providers and pregnant women, limited availability of HepB-BD to vaccination days only, and misconceptions about HepB-BD vaccination (Freeland et al., 2023). The study also identified facilitators such as high vaccine acceptance and willingness for infants to receive HepB-BD if recommended by providers. However, the literature lacks comprehensive studies addressing the implementation strategies and interventions to overcome these barriers and enhance HepB-BD administration and uptake in Nigeria.

The review of national policies in pre-dividend African nations, including Nigeria, by revealed persistent gaps in policies targeting family planning, maternal and child health, education, women's empowerment, and the labor market (Chen et al., 2023). The study emphasized the need for specific policy amendments and alternatives to mitigate these gaps and harness the benefits of a demographic dividend. However, there is a dearth of studies exploring the practical implications and outcomes of implementing such policy amendments and alternatives in the context of Nigeria.

Lastly, the bibliometric review of laboratory ergonomics by highlighted varying trends and nascent patterns in laboratory ergonomics research, including the escalating curiosity in examining the impacts of movement and posture on the physical well-being of laboratory personnel (Abdullah et al., 2023). However, the literature is scant in studies focusing on the application and impact of laboratory ergonomics in laboratory science contributions to women's health in Nigeria.

4.5 Suggestions for Amplified Impact in Women's Health

The literature suggests that there is a substantial need for amplified impact in women's health through laboratory science in Nigeria. The following are suggestions based on the available literature to enhance the impact of laboratory science on women's health in Nigeria. The study by Sholzberg and James underscores the importance of addressing structural sexism in medicine, which negatively affects women's health, especially in the management of bleeding disorders affecting women (Sholzberg and James, 2021). Addressing and rectifying the structural and systemic biases in medical research and healthcare delivery is crucial to ensure equitable healthcare for women. Addressing these biases will facilitate developing and implementing effective interventions and treatments for health conditions predominantly affecting women, thereby improving women's health outcomes.

Furthermore, the study by Otitoju and Otitoju highlights the public health implications of pesticide residues in food samples in Nigeria (Otitoju and Otitoju, 2020). The presence of pesticide residues may pose deleterious effects on food safety and consequently compromise the health of consumers, especially vulnerable populations such as children, elderly, and pregnant women. Therefore, it is imperative to implement stringent regulations and monitoring mechanisms to ensure food safety and reduce the exposure to harmful pesticide residues. Enhancing food safety will improve public health and reduce the risk of health complications associated with exposure to harmful substances.

Moreover, a study emphasizes the need for strategies to increase local labor utilization in industries such as agriculture (Saad et al., 2022). The implementation of strategies such as increasing the level of mechanization, raising the minimum wage, involving youth, and empowering training centers can contribute to addressing labor shortages and enhancing productivity. Similarly, in the context of laboratory science contributions to women's health in Nigeria, it is essential to implement strategies to enhance local capacity, training, and workforce development. Strengthening local capacity will facilitate developing and implementing innovative solutions and interventions to address women's health issues in Nigeria.

Lastly, Jyotsna discusses the importance of encouraging research to fill gaps in medical knowledge about women (Jyotsna, 2017). The creation of common platforms for clinicians and researchers to discuss women-related health diseases is crucial for fostering collaboration and knowledge exchange. Encouraging multidisciplinary clinical and laboratory research work will contribute to a comprehensive understanding of women-related health issues and facilitate the development of effective interventions and treatments.

4.6 Potential Directions for Subsequent Research

The exploration of laboratory science contributions to women's health in Nigeria reveals several potential directions for subsequent research. These directions are crucial to address the existing gaps and enhance the understanding and application of laboratory science to improve women's health outcomes in Nigeria. One potential direction for subsequent research is the exploration of the effects of selective progesterone receptor modulators on uterine and fibroid volume during the treatment of heavy menstrual bleeding (Yin et al., 2023). The study by applied an unbiased method for the analysis of magnetic resonance images and found that the treatment was not associated with a significant reduction in the uterus volume or the uterine fibroids (Yin et al., 2023). Further research in this area can help understand the mechanisms of action and develop effective interventions for conditions affecting the uterus and fibroids, which are prevalent among women in Nigeria.

Another potential direction is the investigation of the impact of homocysteine metabolism during gestation on the prevalence of Spina bifida (Akanni et al., 2020). A group researchers explored the perturbation of homocysteine metabolism in relation to Spina bifida prevalence in Osun State, Nigeria (Akanni et al., 2020). The study highlighted the importance of understanding the metabolic changes during pregnancy and their implications on fetal development. Further research in this area can contribute to the development of preventive strategies and interventions for congenital malformations and other adverse pregnancy outcomes in Nigeria.

Additionally, the exploration of the associations among biological, social, and nutritional status for adolescent women and their babies using electronic health records (EHR) data is a promising research direction (Tobin et al., 2018). A group researchers created a multisite de-identified database from EHRs of female adolescents and their subsequent offspring (Tobin et al., 2018). The study emphasized the importance of understanding the multifactorial determinants of health and their interplay in influencing health outcomes of adolescent women and their babies. Further research in this area can help identify risk factors, develop targeted interventions, and inform policy decisions to improve the health of adolescent women and their offspring in Nigeria.

Lastly, the study of the deposition of bacteria and bacterial spores by bathroom hot-air hand dryers (Huesca-Espitia et al., 2018) suggests a need for research on hygiene and infection control in healthcare and community settings in Nigeria. A group researchers found that many kinds of bacteria, including potential pathogens and spores, can be deposited on hands exposed to bathroom hand dryers (Huesca-Espitia et al., 2018). Further research in this area can contribute to the development of effective hygiene practices and infection control measures to prevent the spread of infectious diseases in Nigeria.

5. Conclusion

5.1 Recapitulation of Principal Discoveries

This review has embarked on a comprehensive exploration of the contributions of laboratory science to advancing women's health in Nigeria, shedding light on the multifaceted approaches and innovations that have been instrumental in addressing the myriad of health challenges faced by women in the region. The journey through the realms of laboratory science and women's health has unveiled significant insights, methodologies, and applications that are pivotal in shaping women's health outcomes in Nigeria.

The introduction of this review delineated the historical context of women's health in Nigeria, highlighting the evolution of health perspectives and the prevailing challenges, particularly focusing on maternal and reproductive health. The historical overview provided a foundation to understand the trajectory of women's health in Nigeria, revealing the persistent struggles and the relentless pursuit of better health outcomes for women. The challenges in women's health were underscored, emphasizing the pressing need for innovative solutions and interventions to address maternal and reproductive health issues, which are paramount in improving the overall health and well-being of women in Nigeria.

The significance of laboratory science in women's health was elucidated, tracing the historical contributions, modern developments, and innovations in laboratory science. The exploration of laboratory science revealed its indispensable role in deciphering the complexities of women's health, offering diagnostic advancements, research, and development in reproductive health, and providing a beacon of hope in the quest for enhanced women's health in Nigeria. The objective and scope of the review were clearly defined, setting the stage for a meticulous examination of the existing literature and a synthesis of the knowledge garnered in the field of laboratory science and women's health.

The methodology section delineated the research strategy, inclusion criteria, the approach to reviewing and synthesizing the existing literature, and the analysis of collected data. The meticulous approach ensured a thorough examination of the relevant literature, enabling the extraction of valuable insights and discoveries pertinent to laboratory science contributions to women's health in Nigeria. The results section provided a synopsis of the reviewed literature, presenting laboratory science initiatives and interventions, diagnostic advancements, and research and development in reproductive health. A case study of a laboratory science initiative in Nigeria was explored, offering a practical perspective on the implementation and impact of laboratory science in real-world settings.

Risk management and mitigation in laboratory science were also discussed, presenting preventive and responsive strategies, partnerships with healthcare providers and institutions, and interactions with health regulatory agencies. The discussion section delved into the efficacy of laboratory science contributions, the obstacles encountered in implementing laboratory science initiatives, and the repercussions for women's health in Nigeria. It also identified gaps in the literature and offered suggestions for amplified impact in women's health, outlining potential directions for subsequent research.

The exploration of the potential directions for subsequent research in laboratory science contributions to women's health in Nigeria has opened new horizons for inquiry and discovery. The studies highlighted in this review have underscored the importance of addressing structural sexism in medicine, enhancing food safety, strengthening local capacity and workforce development, and fostering collaboration and knowledge exchange in clinical and laboratory research work. The research on the effects of selective progesterone receptor modulators on uterine and fibroid volume, the impact of homocysteine metabolism during gestation on the prevalence of Spina bifida, and the exploration of the associations among biological, social, and nutritional status for adolescent women and their babies using electronic health records (EHR) data, have all pointed towards promising avenues for further research and development in the field of women's health.

In conclusion, this review's recapitulation of principal discoveries has painted a comprehensive picture of the landscape of laboratory science contributions to women's health in Nigeria. The journey through the historical context, challenges, significance, methodologies, results, discussions, and potential directions has provided a holistic view of laboratory science's advancements, innovations, and future prospects in enhancing women's health in Nigeria. The insights and knowledge garnered from this review are instrumental in guiding future research, policy decisions, and interventions aimed at improving the health outcomes of women in Nigeria, ultimately contributing to the well-being and prosperity of the nation.

5.2 Future Prospects of Laboratory Science in Enhancing Women's Health in Nigeria

The exploration of laboratory science contributions to women's health in Nigeria has illuminated the path for future prospects in enhancing women's health through innovative and multifaceted approaches. The advancements and discoveries highlighted in this review signify a beacon of hope and a foundation upon which future endeavors can be built to elevate the health outcomes of women in Nigeria.

The future of laboratory science in women's health in Nigeria holds immense potential for developing and implementing groundbreaking interventions and treatments. The advancements in diagnostic technologies and methodologies are poised to revolutionize the detection and management of health conditions predominantly affecting women, enabling early intervention and improved health outcomes. The continuous research and development in reproductive health are pivotal in addressing the pressing challenges in maternal and reproductive health, offering new insights and solutions to mitigate the risks and enhance the well-being of women.

Moreover, the future prospects include strengthening partnerships with healthcare providers and institutions, fostering collaboration and knowledge exchange to drive innovation and excellence in women's health. The interactions with health regulatory agencies will be crucial in shaping policies and regulations that support the advancement of laboratory science in women's health, ensuring the safety, efficacy, and

accessibility of health interventions and treatments. The potential directions for subsequent research identified in this review, such as the exploration of the effects of selective progesterone receptor modulators on uterine and fibroid volume and the investigation of the impact of homocysteine metabolism during gestation on the prevalence of Spina bifida, are indicative of the myriad of opportunities for exploration and discovery in the realm of women's health. These research directions are instrumental in filling the existing gaps in knowledge and in developing effective preventive and therapeutic strategies to address the diverse health needs of women in Nigeria.

Furthermore, the emphasis on addressing structural sexism in medicine, enhancing food safety, and strengthening local capacity and workforce development are paramount in shaping the future landscape of women's health in Nigeria. The commitment to addressing the multifactorial determinants of health and their interplay in influencing health outcomes will be pivotal in developing holistic and sustainable approaches to improving women's health.

In essence, the future prospects of laboratory science in enhancing women's health in Nigeria are promising and multifaceted, encompassing advancements in diagnostics, treatments, research, collaborations, policy development, and capacity building. The convergence of knowledge, innovation, and commitment is poised to usher in a new era of hope and progress in women's health in Nigeria, contributing to the realization of equitable and optimal health for all women in the nation.

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