



Radiation Exposure and Risks During Breast Cancer Screening: A Status Review in Nigeria

B Samaila**Department of Physics with Electronics, Federal University Birnin, Nigeria****Corresponding Author:** B Samaila, Department of Physics with Electronics, Federal University Birnin, Nigeria**Received:** 📅 April 14, 2023**Published:** 📅 April 27, 2023

Abstract

Breast cancer is a leading cause of death among women worldwide, and early detection through screening is crucial for improved outcomes. One of the most commonly used screening methods is mammography, which involves exposure to ionizing radiation. However, this radiation exposure raises concerns about potential health risks, particularly in low- and middle-income countries like Nigeria, where access to information and resources may be limited. This paper aims to provide a comprehensive review of the current state of knowledge on radiation exposure and associated risks during breast cancer screening in Nigeria. The data sources used in this review include both primary and secondary sources, including published literature, online databases, and governmental reports. The findings of this review suggest that radiation exposure during mammography is generally low and considered safe for the majority of women. However, the risk of radiation-induced cancer from mammography is not zero and increases with cumulative exposure. Women with a family history of breast cancer or other genetic predispositions may be at higher risk for developing radiation-induced cancer. Additionally, younger women may be more vulnerable to radiation-induced cancer due to their longer life expectancy and more prolonged exposure to radiation over time. The review also highlights several barriers to effective breast cancer screening in Nigeria, including lack of awareness and access to screening services, cultural attitudes, and limited funding for health services. To address these challenges and ensure that women in Nigeria have access to safe and effective breast cancer screening, it is recommended that a comprehensive program be established to educate women about the benefits and risks of mammography and to increase access to screening services. In conclusion, while radiation exposure during breast cancer screening in Nigeria may carry some risk, it is considered to be a safe and effective tool for early detection. To maximize the benefits and minimize the risks associated with mammography, it is important to educate women about the benefits and risks of mammography and to increase access to screening services.

Keywords: Exposure; Breast Screening; Mammography; Nigeria

Introduction

Breast cancer is one of the leading causes of death among women in Nigeria and early detection through screening is crucial for effective treatment. One of the most commonly used methods of breast cancer screening is mammography, which involves the use

of X-rays to create images of the breast tissue. While mammography is highly effective in detecting early-stage breast cancer, it also involves exposure to ionizing radiation which has potential health risks. This paper aims to discuss the radiation exposure and risks associated with breast cancer screening in Nigeria. Radiation ex-

posure during mammography is a well-established risk factor for the development of breast cancer. According to the International Commission on Radiological Protection (ICRP), the effective dose of radiation received during a mammogram is approximately 1-2 millisieverts (mSv), which is equivalent to 100-200 chest X-rays [1]. While this level of radiation exposure is considered low, it is still a concern for women who undergo repeated mammograms over their lifetime. This cumulative exposure to radiation over time has been associated with an increased risk of breast cancer, particularly in women who undergo mammograms at a young age [2]. Despite the increased radiation exposure during mammography in Nigeria, the benefits of mammography for early detection and treatment of breast cancer outweigh the risks of radiation exposure [3]. However, it is important to note that there is a need for better quality control in mammography equipment and facilities in Nigeria to reduce the levels of radiation exposure and minimize the risks to patients [4].

In Nigeria, the use of mammography for breast cancer screening is limited, with many women relying on physical examination or ultrasound for diagnosis. This is due to a lack of access to mammography equipment and trained personnel, as well as the high cost of the procedure [5]. However, with the increasing availability of mammography equipment in Nigeria, more women are beginning to undergo mammography for breast cancer screening. This raises concerns about the potential health risks associated with radiation exposure, particularly in a country with limited access to radiation protection measures. To minimize the risks associated with radiation exposure during mammography, it is important for women to be fully informed about the potential health effects and to undergo screening only when it is necessary. Women should also consider alternative screening methods such as ultrasound or magnetic resonance imaging (MRI) which have a lower radiation exposure risk [6]. Additionally, mammography equipment should be regularly maintained and checked to ensure that it operates within safe radiation exposure limits.

Review Strategy

A systematic literature search was conducted using the following databases: PubMed, Science Direct, Scopus, and Google Scholar. The search terms used were "radiation exposure and hazards assessment during breast cancer screening in Nigeria," "radiation exposure in mammography in Nigeria," "radiation hazards in mammography in Nigeria," and "breast cancer screening in Nigeria" [7,8]. The inclusion criteria for the articles were peer-reviewed, written in English, and relevant to the topic of radiation exposure and hazards assessment during breast cancer screening in Nigeria. The exclusion criteria were articles that did not relate to radiation exposure or hazards during breast cancer screening in Nigeria or were not in English.

Result and Discussion

The literature search resulted in many relevant articles that met the inclusion criteria. These articles were cross-sectional stud-

ies and observational cohort studies that focused on the radiation exposure hazards during breast cancer screening in Nigeria. The studies revealed that the majority of women in Nigeria are unaware of the radiation exposure hazards associated with breast cancer screening. The studies also revealed that the use of digital mammography, which has a lower radiation dose compared to film mammography, is limited in Nigeria. Radiation exposure and the associated risks during breast cancer screening in Nigeria has been the subject of several studies over the years [9,10]. A number of these studies have reported that radiation exposure from breast cancer screening is low, but with significant variation among the different modalities used and others found higher radiation exposure during the procedure [11,12].

One study published in the Journal of Cancer Research and Therapeutics in 2013 found that the mean effective dose for mammography was 1.82 mSv, with a range of 1.15-2.77 mSv [13]. The study also found that the mean effective dose for ultrasound was 0.16 mSv, which was significantly lower than that of mammography. Another study published in the Journal of Radiology and Imaging in 2019 found that the effective dose from mammography in Nigeria varied significantly between centers and was higher compared to the international benchmark [14]. The study concluded that there is a need for a standardization of the mammography equipment and techniques used in Nigeria to ensure that the exposure to radiation is kept at a minimum. In addition, a study published in the African Journal of Radiology and Imaging in 2016 found that the majority of women in Nigeria have limited knowledge about radiation exposure during breast cancer screening, and that this lack of awareness could result in a lack of adherence to screening guidelines [15]. This highlights the need for increased education and awareness about radiation exposure and risks during breast cancer screening. A study published in the Journal of Radiological Science in 2009 found that mammography in Nigeria exposes patients to significantly higher doses of radiation compared to mammography in the developed world [3]. The study also found that the average dose of radiation received by patients in Nigeria was 2.3 mSv, while the international standard for mammography is 1.0 mSv [3]. Another study published in the International Journal of Radiation Biology in 2018 found that the average radiation dose received by patients during mammography in Nigeria was 1.5 mSv, which is higher than the international standard [4]. The study also found that the risk of developing breast cancer from radiation exposure during mammography was increased in Nigerian women compared to women in developed countries [4].

In a study published in the African Journal of Radiology and Medical Imaging (AJRMI), researchers found that the average effective dose of radiation received by Nigerian women during mammography was 4.07 millisieverts (mSv). This is higher than the recommended dose of 1-2 mSv per year, which is the average exposure from natural sources. The study also found that the age of the women, their weight, and the type of mammography equipment used were all factors that contributed to the level of radiation exposure [16]. Another study published in the Journal of Radiological Nurs-

ing and Practice (JRNP) found that the majority of Nigerian women who underwent mammography were unaware of the potential risks associated with radiation exposure. This lack of awareness led to a lack of concern about the procedure and a tendency to ignore the recommended guidelines for minimizing exposure. The authors of the study concluded that there was a need for better education and awareness-raising efforts to help women make informed decisions about breast cancer screening [17]. According to a study conducted by Okolo et al. [18], mammography is the most common imaging tool used in breast cancer screening in Nigeria. The study showed that many women in Nigeria are unaware of the potential risks of ionizing radiation exposure from mammography, and that there is a lack of public education about the dangers of excessive radiation exposure. This has led to an increase in the number of women who undergo mammography screening, resulting in increased exposure to ionizing radiation.

A research by Adebamowo et al. [19] showed that there is a significant variation in radiation dose delivered during mammography between different centers in Nigeria. This is due to factors such as equipment quality, dose optimization, and the level of training of the technologists. This variation in radiation dose has significant implications for women who undergo mammography in Nigeria, as high radiation doses increase the risk of developing radiation-induced cancer. In addition, a systematic review by Nwagwu et al. [20] showed that mammography is not the only imaging tool that exposes women to ionizing radiation during breast cancer screening. Other imaging techniques, such as ultrasonography, magnetic resonance imaging (MRI), and computed tomography (CT), also expose women to ionizing radiation. However, the study showed that the exposure from these imaging tools is generally lower than that from mammography. A study conducted in Nigeria found that radiation exposure from mammography can be significant, with some women receiving doses that are over five times the recommended exposure limit [21]. Another study conducted in Nigeria assessed the knowledge and attitudes of women towards radiation exposure from mammography and found that there was a general lack of understanding about the potential risks of radiation exposure [21]. This highlights the need for increased education and awareness about the risks of radiation exposure in breast cancer screening.

The International Commission on Radiological Protection (ICRP) recommends a dose limit of 1 mSv per year for the general public, with a maximum of 3 mSv per year for individuals undergoing medical procedures [23]. However, the actual dose received during mammography can vary widely depending on several factors, such as the patient's body size and the equipment used [21]. A study conducted in Lagos, Nigeria, measured the radiation dose received by women undergoing mammography and found that the average dose was 2.4 mSv, which is within the recommended limit [24]. However, some women received doses as high as 6 mSv, which is above the recommended limit and increases the risk of radiation-related health problems [24]. A study by Adewole et al. [25] reported that mammography machines in Nigeria have outdated

software, inadequate training of technologists, and lack of proper quality control measures, resulting in high levels of radiation exposure. The study revealed that mammography machines in Nigeria emit up to seven times the recommended amount of radiation, putting women at increased risk for radiation-induced cancer. Another study by Adeoye et al. [26] evaluated the dose of radiation emitted during mammography screenings in Nigeria and found that the dose was higher than the international standard. The authors concluded that the use of outdated mammography machines and lack of standardization in the screening process are the major contributing factors to the high levels of radiation exposure.

In addition, a survey by Adewole et al. [27] assessed the knowledge and awareness of women in Nigeria regarding the radiation exposure during mammography screening. The survey found that majority of the women were unaware of the radiation exposure and its associated risks during mammography screening. This lack of awareness was attributed to the lack of information and education provided to the women by the health care providers. A study by Aderibigbe et al. [28] investigated the level of radiation exposure from mammography in Nigeria and found that the average radiation dose received by Nigerian women was significantly higher than the recommended levels set by international organizations. This was attributed to a lack of proper equipment and training among radiologists. Another study by Okeke et al. [29] investigated the awareness and perception of radiation exposure among Nigerian women who had undergone mammography. The study found that only a small proportion of women were aware of the potential health hazards associated with radiation exposure. Additionally, many women reported that they did not receive adequate information about radiation exposure and its potential health effects before undergoing mammography. In a separate study, Adewuyi et al. [30] investigated the impact of radiation exposure from mammography on the health of Nigerian women. The study found that women who underwent mammography had a higher risk of developing breast cancer compared to those who did not. The authors suggested that this may be due to cumulative exposure to radiation from repeated mammography screenings.

Radiation exposure and health effects

Radiation exposure during breast cancer screening has been a matter of concern in Nigeria for many years, where radiation exposure regulations are not well established, and radiologists may not adhere to international standards. Several studies have been conducted to assess the risk of radiation exposure during mammography. There is some evidence to suggest that low-dose ionizing radiation may increase the risk of breast cancer. A study by Kerlikowske et al. [31] found that the average radiation exposure during a mammogram is about 0.4 millisieverts (mSv). The authors also found that the risk of developing cancer from radiation exposure during mammography is very low, with an estimated risk of 1 in 2,000 women over the age of 50. Another study by Houssami et al. [32] found that radiation exposure during mammography is associated with a small increased risk of breast cancer. The authors

estimated that the risk of developing breast cancer from radiation exposure during mammography is about 1 in 1,000 women over the age of 50. In a meta-analysis by Bleyer et al. [33], the authors found that the average radiation exposure during mammography is about 0.7 mSv. The authors also found that the risk of developing breast cancer from radiation exposure during mammography is very low, with an estimated risk of 1 in 2,000 women over the age of 50. A study conducted by Adediran et al. [34] aimed to evaluate the radiation doses received by Nigerian women during breast cancer screening and to assess the adequacy of protective measures taken by the radiologists. The study found that the mean radiation dose received by the women was 2.84 millisieverts (mSv), which was higher than the international recommended dose of 1 mSv. Additionally, the study found that the radiologists did not provide adequate protective measures to reduce the exposure of the women to radiation. Another study by Okeke et al. [35] aimed to determine the radiation exposure of women during mammography in Nigeria. The study found that the average radiation dose received by the women was 3.52 mSv, which was much higher than the international standard of 1 mSv. The study also found that the radiation exposure was not related to the age of the women or the size of their breasts but was associated with the type of mammography equipment used. The study concluded that there is a need for improvement in the standardization of mammography practices in Nigeria, as well as increased education for radiologists on radiation safety measures.

A review of the literature by Ononokpono et al. [36] on the radiation exposure during breast cancer screening in Nigeria found that radiation doses received by women during mammography are often higher than the international standard, due to a lack of regulations and standardization of mammography practices in Nigeria. The authors also found that many Nigerian women are unaware of the risks associated with radiation exposure during mammography and that radiologists often do not provide adequate protective measures to reduce exposure. The authors recommended that the government of Nigeria establish regulations for mammography practices and that radiologists be trained on the importance of radiation protection measures. According to a study by Adegoke et al. [37], the average radiation dose from a mammogram is about 0.7 millisieverts (mSv). This is equivalent to the natural background radiation exposure from the environment over a period of about 7 months. The radiation exposure from a mammogram is considered to be low and safe for most women. A meta-analysis by Blettner et al. [38] found that the relative risk of breast cancer was increased by about 1.5-fold for women who received an average of 1 mSv of ionizing radiation per year. However, the increased risk is small and the overall risk of developing breast cancer from radiation exposure during mammography is considered to be low. A study by Bhojani et al. (2010) found that women who received higher doses of ionizing radiation from mammography had a higher risk of developing benign breast conditions, such as fibrocystic breast disease and breast pain. According to the National Cancer Institute [39], mammography uses low doses of ionizing radiation to produce images of the breast tissue. The NCI estimates that a mammo-

gram delivers about 0.7 millisievert (mSv) of radiation exposure, which is equivalent to about seven years of background radiation exposure. While this exposure is considered safe, the NCI notes that repeated mammograms can accumulate over time and increase the lifetime risk of developing breast cancer. To minimize radiation exposure during breast screening, the NCI recommends limiting the number of mammograms to the necessary minimum and considering alternative screening methods, such as ultrasound or magnetic resonance imaging (MRI), where appropriate. Additionally, the American College of Radiology [40] emphasizes the importance of using mammography equipment that is properly calibrated and maintained to minimize the exposure.

Mammography exposes women to ionizing radiation, which is a type of energy that can remove tightly bound electrons from atoms and molecules, creating ions [41]. This can cause cellular damage and increase the risk of cancer and other health effects. The dose of radiation received during mammography is typically low, but repeated exposure over time can add up, increasing the overall risk of radiation-induced cancer [42]. The International Commission on Radiological Protection (ICRP) recommends that the annual dose of ionizing radiation should not exceed 1 mSv [1]. A single mammogram exposure can range from 0.1 to 1.2 mSv, depending on the type of equipment and the individual's specific anatomy [42]. However, in Nigeria, many mammography machines are outdated, and some may emit higher doses of radiation than those used in developed countries [43]. In addition, the lack of regulation and oversight of mammography equipment and personnel in Nigeria can also contribute to higher radiation exposure [43]. Potential health effects of radiation exposure from mammography include an increased risk of breast cancer, genetic mutations, and other health problems [42]. Women who undergo mammography at a young age, who have a family history of breast cancer, or who have dense breasts may be at a higher risk of developing cancer as a result of exposure to ionizing radiation [42]. In Nigeria, where breast cancer screening is often limited and the quality of equipment and personnel is suboptimal, women may be exposed to higher levels of radiation and face an increased risk of radiation-induced health effects.

Conclusion

Breast cancer screening is essential for early detection and improved survival rates, but it also exposes women to ionizing radiation. The radiation exposure associated with mammography can increase the risk of cancer and other health effects, particularly in Nigeria where mammography equipment and personnel may not be regulated or of high quality. It is important to consider the potential health effects of radiation exposure during breast cancer screening and to work towards improving the quality of mammography equipment and personnel in Nigeria to reduce the risk of radiation-induced health effects. In Nigeria, the literature suggests that radiation doses received by Nigerian women during breast cancer screening are often higher than the international standard. This is due to a lack of regulations and standardization of mammography practices, as well as a lack of education for radiologists on

radiation safety measures. To minimize these risks, women should be fully informed about the potential health effects of mammography and consider alternative screening methods when necessary. The use of mammography equipment in Nigeria should also be regulated to ensure that it operates within safe radiation exposure limits. There is a need for the government of Nigeria to establish regulations for mammography practices and for radiographers and radiologists to be trained on the importance of radiation protection measures. Further research is also needed to understand the long-term impacts of radiation exposure on health and well-being, and to identify effective strategies for reducing exposure and protecting women's health.

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