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Screening Depression and Mental Distress by Using Ai-Powered Tools Among Women with Breast Cancer. A Review

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ABSTRACT

Breast cancer (BC) is the most common cancer diagnosed in women across the world. Surviving and coping with cancer is often extremely stressful for both patients and their families. The purpose of this review is to appraise artificial intelligence-related recent advances that can be employed for early screening and diagnosis of depression and other mental health problems among women with breast cancer. Depression, anxiety post-traumatic stress disorder amongst breast cancer patients along with other mental health issues is often misdiagnosed and undertreated. Screening of depression is often challenging in breast cancer women due to time restraints and less trained staff for using traditional tools for its assessment. Review is supportive of the fact that Artificial intelligence empowered tools are proving themselves to be more effective and efficient psychotherapeutic approach. They require less time and utilize patient and health provider related data for timely screening and diagnosis of mental health issues.

INTRODUCTION

In 2020, Malignant breast cancer has surfaced as a major concern affecting health of women across the world, they have exceeded lung tumors to be malignant with the highest incidence rates globally (Haun et al., 2021).Incidence of cancer is increasing globally (Martin et al., 2020) however depression manifests more in survivors of cancer having chronic disease comorbidities (Yan et al., 2019) and women survivors with breast cancer (Doege et al., 2020) due to heterogeneity of signs and symptoms of depression in cancer patients.

In the last decade breast cancer was a top lead cause of mortality in women internationally that demanded extensive research for effective early detection and prevention strategies. In 2020, around 2.3 million women with breast cancer were diagnosed and 33.5% among them were fatal (WHO, 2022). Despite major advances in understanding biological features and risk factors involved in breast cancer, significant challenges continue to exist in clinical and preventive interventions for managing breast cancer.

Individuals with breast cancer are often astounded because of ongoing treatment, which leads to various concerns (Corey et al., 2020). Despite there is less depiction in scientific literature yet social-emotional challenges (Thorn., et al. 2021), cancer-related fatigue (CRF) (Bower., et al. 2018) and physical functional limitations (Tauscher et al., 2019), are found pragmatic. Literature shows that breast cancer women experienced intense fatigue after treatment. Severity is affected significantly by distress, sleep disruption and lower social and physical health (Scott et al., 2020). There exist an association between the stressful life happening in the form of breast cancer and downfall in physical state accelerates possibility for a skewed rating of motivational, emotional and psychological health aspects (Cairney et al., 2019). Administration of general anesthesia (Pei et al., 2019)] and changes in hormonal levels (Boing et al., 2020) can be regarded as underlying mechanisms affecting overall psychological wellbeing.

Artificial intelligence (AI) proposes promising solutions for improving overall mental health. AI tools have capacity to analyze complex and multidimensional data. It can proficiently integrate predictors of depression like sleep satisfaction, mood, and anxiety for precise screening of depression. These AI- powered tools are greatly valued in LMICs, where healthcare systems are facing substantial challenges while scaling up traditional approaches (Pillai., (2023).

Breast cancer is amongst most common cancer in women across Pakistan, with a major number of breast cancer patients experiencing psychological disturbances that includes depression, anxiety, and sleep (Azam et al., 2021). In spite of the high prevailing mental health problems among breast cancer women, less has been done for improving psychological screening within oncology care in Pakistan. Conventional tools such as Patient Health Questionnaire (PHQ-9) are seldom employed due to time limitations, lack of trained staff, and stigma linked with mental health problems (Marshall., (2023).

There exists a critical gap in development and validation of local AI models customized to Pakistan's contextual healthcare system, which is undoubtedly facing challenges of limited access and awareness to digitized technologies being used in mental health. Ongoing research in Pakistan about AI in healthcare mainly focuses on physical health conditions and their diagnosis, with negligible consideration for mental health applications. It highlights the need for scalable, innovative, and culturally adapted AI-based solutions for screening mental health distress in cancer care (Kazi et al., 2020)

DEPRESSION, ANXIETY AND MENTAL HEALTH

Breast cancer patients mainly experience various concomitant psychological indications during the course of their cancer care. It includes anxiety, depression, distress, cognitive damage, sexual dysfunction (Guimond et al., 2019) professional, familial, and body image (Corey et al., 2020).

Anxiety, depression or chronic stress may influence risk factors of breast cancer (S. Kim & Jo, 2023) further affecting quality of life among survivors (Vagnini et al., 2024). In women with breast cancer depression, anxiety and distress negatively affect their treatment strategy, self-care, quality of life (QoL), and immunity and reduces survival chances (Boing et al., 2019).

The factors further contributing to occurrence of depression and anxiety among breast cancer individuals are multifaceted and complex. Earlier research primarily focused on individual features related to demography, symptomology as fatigue, weakness, fatigue, insomnia, pain and clinical factors to be the major predictors (Haun et al., 2021), however multiple factors beyond cancer itself are likely to contribute in developing depression.
The factors further contributing to occurrence of depression and anxiety among breast cancer individuals are multifaceted and complex. Earlier research primarily focused on individual features related to demography, symptomology as fatigue, weakness, fatigue, insomnia, pain and clinical factors to be the major predictors (Haun et al., 2021), however multiple factors beyond cancer itself are likely to contribute in developing depression.
Psychological positive abilities of resilience and hope, self-efficacy and control, and experiences of recovery are negatively related to develop anxiety and depression. Self-control among these correlates to the ability of an individual psychologically to control their emotions, behavior, and thoughts to achieve long lasting goals, resist impulses, and follow social values. It's considered as an important facet of regulating own self which is essential for success in numerous domains of life like work performance, psychological health and academic achievement (Di Corrado et al., 2022).
Even during COVID-19, delayed, interrupted treatment and impact on income were main risk factors contributing to anxiety and CDA. Hence, psychological complications in breast cancer patients may be instigated by physiological distress caused by both breast cancer and its treatment resulting in feelings of anxiety. Moreover, breast cancer treatment and diagnosis may affect family and social lives of patients with financial stress, family conflicts and job loss which in return can further contribute to anxiety related symptoms (Fortin et al., 2021).
Research shows that nearly half of cancer patients suffer from depression and anxiety reducing their long-term survival rates by 10%–20% (Aggeli et al., 2021). It is an established fact that breast cancer patients face severe depression, anxiety, and comorbid depression and anxiety (CDA). In a study by Yang et al., prevalence rates of anxiety, depression and CDA were found to be 21.9%, 35.1%, and 14.7%, respectively in their sample. Depression was found more prevalent in this study than reported by a study in Taiwan (6.92%). Further to it, anxiety was significantly higher than was in Taiwanese study (15.9%) (Yang et al., 2022) and American study conducted during the COVID-19 pandemic (29.1%) (Shah et al., 2022). However, the rate of CDA found in study by Yang et al., were much lower than found in a Ghanaian study (29.4%) (Kugbey, 2022).Prior researches show that chronic body pains can not only cause physical weakening but also increase the odds of having emotions as depression and anxiety (Ji et al., 2018).In short depression and anxiety are major factors affecting psychological well-being of both cancer and more specifically breast cancer patients.
In another study found self-control was found to be inversely related to depression, anxiety, and CDA which is consistent with previous findings (Xiao et al., 2022), and shows that self-control has a predictive effect on depression, anxiety, and CDA (Ahmed et al., 2022). Another study by Venables et al., also showed self-control to be negatively associated with negative emotions of depression and anxiety (Venables et al., 2017). Conversely, low self-control might make oneself more prone to experience symptoms of depression (Shroff et al., 2021).

Elderly BC Patients and Psychological Profile

In comparison elderly women with breast cancer have been found to have decreased recurrence fear as compared to young women with breast cancer. Young women survivors of breast cancer reveal an increased fear within the initial 1.5-year post surgery while fear levels were found

stable during the first 6 months in older survivors which declined later in their lives. (Starreveld et al., 2017).

Also, web-based intervention (e-health) resulted in significant support for elderly BC patients during their upcoming chemotherapy and offered them effective coping strategies (Villani et al., 2018).

Cancer and post-traumatic stress disorder

Cancer experience is assertively traumatic for many patients leading to psychological consequences even post-traumatic stress disorder (PTSD). Cancer patients frequently report nightmares about cancer treatment, its recurrence and future. Evidence showed rates ranging from 3 to 22% of lifetime cancer-related PTSD in long-term cancer survivors (Carletto et al., 2019).

Body Image and Sexual Dysfunctions

Body image is a multidimensional construct which is mental depiction about one's physical attractiveness, appearance and competence, alongside perceived state of overall health, functioning, and sexuality. Although body image disorders usually recover over time however breast cancer survivors experience concerns related to body image in spite of breast reconstruction or conservation techniques (Esplen et al., 2018).

In Women with breast cancer, 73.4% suffer from sexual dysfunctions, making them a high-risk group. It is perhaps due to specific treatment experiences like breast surgery, hormonal treatments coupled with psychological and physiological effects of both chemo and radiotherapy (Bober et al., 2019).

Depression Screening Tools

Cancer distress **screening tools** are found significant still health care systems have to struggle constantly for their practical implementation (Knies et al., 2018). It is due to a smaller number of staff that too striving to differ between distress of mental health and disease symptoms limitations with accessibility and availability of services representing majorly as barriers to regular screening (Granek et al., 2018).

Health data and outcomes reported by patients, is gaining a significant value as a tool to understand sign and symptoms faced by cancer patients and survivors (Jim et al., 2020). It gives direct perspective of patients and can be helpful in taking decisions by relying on inputs given about changing experiences in their quality of life that corresponds to adverse events related to clinician (Austin et al., 2019). Digitized interventions focused on collecting patient-reported effects are being acknowledged as more practical and acceptable by both clinicians and patients (Wright et al., 2018).

Interpretation and reporting biases are even more marked among individuals suffering from depression (Urban et al., 2018). Moreover, negligent responses and feeling of being socially desirable may further misrepresent the quality of results (Obinson et al., 2021). Presently, artificial intelligence is offering new openings for screening and prediction of outcomes related to mental health.

ARTIFICIAL INTELLIGENCE, BREAST CANCER AND DEPRESSION

Screening for psychological effects in cancer patients is documented as vital however numerous barriers exist for its effective implementation (Granek et al., 2018). Most commonly used method is self-reporting which can cause considerable bias while reporting experience and it becomes more distinct in individuals with depression (Obinson et al.,2021). So there exists a need to better detect psychological distress in cancer survivors. Extensive data and artificial intelligence propose new avenues to identify psychological distress among cancer patients by

building connections between observable indications and psychological conditions of a person. Low and colleagues (Low et al., 2020) suggested improved screening in psychological distress by artificial intelligence due to spontaneously generated cues of psychological situations.

Cancer diagnosis and treatments impact patients' psychological well-being enormously. Cancer survivors suffer often with anxiety and depression along with physical odds of treatment. Comorbid mental health problems affect around one-third of cancer patients (Singer, 2013).Symptoms are often overlooked in long-term survivors and patients despite professional support during cancer diagnosis and treatment (J. H. Kim et al., 2019).Machine learning (ML) is encouraged as a tool to be applied increasingly in cancer research for predicting patient related outcomes while identifying risk factors for numerous other cancer related concerns such as psychological distress of depression and anxiety (Kourou et al., 2021). ML algorithms can help to analyze huge data sets, recognize predictors and their relationships which cannot be identified while using conventional statistical methods of logistic regression analysis (Handelman et al., 2018). Depression and anxiety being faced during treatment for breast cancer majorly effect treatment outcomes. Therefore, it can help doctors to better identify patients with increased risk of psychological distress and help them to improve mental health and life satisfaction among patients.

Artificial intelligence (AI) integration in managing breast cancer includes various features ranging from diagnosis, survival rate estimation, recurrence prediction, and assessing treatment response. Multiple studies (Alfian et al., 2022) reflect the efficacy of machine learning models, which achieved 80.23% accuracy while diagnosing breast cancer at early-stage by efficient selection of critical risk factors. Similarly (Alzu'bi et al., 2021) machine learning can be implemented to make predictions about breast cancer recurrence by focusing wide range of factors taken from electronic health records such as medications, medical recommendations, lab results, past medical and family history, procedures, imaging, allergies, and other clinical documents.

Machine Learning Models

Machine learning algorithms recently have shown promising results to analyze complex datasets for predicting symptoms related to depression based upon clinical and behavioral data (Lee et al., 2018).

Natural Language Processing (NLP)

This technique of natural language processing works by analyzing textual data from patient clinical notes and narratives for identifying depression markers. Studies have shown that utilizing this technique of NLP helps by extracting emotional cues and depressive symptoms from electronic health records (Koleck et al., 2019).

Wearable and Mobile Technologies

Wearable devices, and smartphone applications powered with artificial intelligence continue to monitor behavioral and physiological indicators of different patterns of sleep, speech, and activity levels which can be correlated with depression (Zafar et al., 2024). These tools offer factual insights to facilitate continuous monitoring of symptoms relevant to depression and anxiety.

CLINICAL APPLICATIONS OF AI TOOLS AND DEPRESSION

Screening Tools

AI-supported tools, for instance digital assistants and chat-bots can provide accessible and scalable suggestions for depression screening initially. These tools can help involve patients in

structured and specified conversations for assessing their mood and levels of anxiety (Pavlopoulos, Rachiotis, Maglogiannis., 2024)

Decision Support Systems

AI-powered systems can assist clinicians in decision making by identifying high-risk patients and providing tailored interventions for them for instance, predictive models developed according to AI algorithms can help prioritize patients for their psychological assessment (Pavlopoulos, Rachiotis, & Maglogiannis ., 2024)

Personalized Interventions

Artificial intelligence is being utilized for developing personalized treatment plans by examining patient data pertaining to an individual. AI systems can further suggest specified therapeutic interventions depending upon unique profile of patient (Yogeshappa .,,2024).

CHALLENGES AND LIMITATIONS

Data Quality and Bias

One of the prime challenges for using AI models entails diversified and high-quality datasets for predicting accurately. Data scarcity while training datasets can bound generalizability (Ku & Min 2024, March).

Ethical Concerns

Data Privacy, security, and taking informed consent are critical and perilous concerns while engaging with AI applications. Ensuring ethical utility of data related to patient yet remains a substantial challenge (Williamson & Prybutok ., 2024).

Integration with Clinical Workflows

Integration of AI systems into current clinical workflows will be requiring noteworthy investments for training and creating infrastructure to support AI- based systems. Resistance for adopting to such massive changes in healthcare providers is a huge challenge to impede its implementation (Nair., 2024)

FUTURE DIRECTIONS

Combining and integrating data from diversified sources as medical imaging genomics, and wearable or smartphone devices, can prove helpful to improve reliability and accuracy of AI models.AI technologies which are capable of processing real-time data can be of great use for continued monitoring and intervention for symptoms of depression in its early stages. Inter-sectoral collaboration in oncologists, data scientists, psychologists, and ethicists is utmost to augment the development and implementation of AI tools.

CONCLUSION

AI has colossal potential which can help revolutionize care for depression and mental health among breast cancer patients. By leveraging progressive analytical and predictive modeling, AI can boost early detection, improve outcomes and personalize treatment. Nonetheless, challenges related to data quality, clinical integration and ethical considerations is vital to be realized in its full potential. Persistent and continuous research with collaboration is obligatory to warrant AI tools as effective, accessible and equitable. The literature emphasizes the critical need for inventive AI- related approaches in mental health distress screening among breast cancer patients. This study seeks to develop AI-based tools designed to address the distinctive requirements of breast cancer patients' further paving way for enhanced mental health results and holistic care for breast cancer patients.

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