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Original Research Article

Future Trend of Gynaecological Malignancy in Tamil Nadu – A Forecasting Analysis

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Abstract:

Background: According to GLOBOCAN 2020 Project data, breast cancer, cervical cancer, ovarian cancer, and uterine cancer are among the top 10 common cancers in females worldwide. Accurate projections of cancer incidences and mortality are required for effective and efficient policymaking as well as for adequate resource allocation. This study will forecast the incidence of various gynaecological cancers in Tamil Nadu.

Methods: The incidence of various gynaecological malignancies in Tamil Nadu for the years 2012 to 2021 was obtained from the Tamil Nadu Cancer Registry Project (TNCRP). Auto regression integrated moving average (ARIMA) model was utilised to forecast the incidence of various gynaecological malignancies in Tamil Nadu up to the year 2030.

Results: The incidence of new cases in 2021 was as follows (Breast cancer - 11657, ovarian cancer - 2287, Cervix cancer - 6668, other genital cancer – 2570), was taken as baseline. The projected new case incidence using ARIMA showed a 30% increase from the baseline 2021 values of Breast cancer (15155 with 95% C.I. 12795-17515), similarly the incidence of Ovarian cancer was predicted to have a 20% increase (2746 with 95% C.I - 2295-3197) and a staggering 48% increase in Other genital cancer (3811 with 95% C.I. 3079-4544) by the year 2030 when compared to the baseline values. There is a 1% decrease in cervical cancer (6737 with 95% C.I. 4542-8933) by 2030.

Conclusion: This analysis using the ARIMA model shows that there will be an increasing trend in hormone-related and lifestyle-related gynaecological malignancies and a decreasing trend in infection-related malignancies. This trend analysis will help to pave a pathway towards future introduction of new policies, justify an increase in resource allocation and to create awareness and screening programs for gynaecological malignancies other than breast and cervical cancer to tackle the challenge of disease dynamics.

Keywords: Gynaecological malignancy, ARIMA, Trend analysis.

Introduction

Gynaecological cancer refers to a group of cancers that originate in the female reproductive system, which includes cancers of the ovary, cervix, endometrium (lining of the uterus), vulva, and vagina (Richard R. Barakat et al., n.d.). According to the Global Cancer Observatory (GLOBOCAN) 2020 data, there were approximately 1.3 million new cases of gynaecological cancers worldwide, with around 700,000 deaths (GLOBOCON 2020, n.d.). Breast cancer, cervical cancer, ovarian cancer, and uterine cancer are among the top ten most common cancers in women worldwide. Recent estimates indicate that female breast cancer has become the most prevalent cancer globally, surpassing lung cancer in terms of incidence (Yi et al., 2021). Compared to cervical cancer, both ovarian cancer and uterine cancer occur less frequently on a global scale. However, the incidence and mortality rates of these four types of cancers affecting women have generally been on the rise over the past few decades (Zhao et al., 2022) (Cabasag et al., 2020). ICMR-NCDIR National Cancer Registry Programme reports says that there is an increasing trend in breast & uterine cancer in India. However, there is lack of availability of reports among other gynaecological malignancies (ICMR-NCDIR National Cancer Registry Programme estimates 12% increase in cancer cases in the country by 2025, 2020). In Tamil Nadu, breast cancer is the most common cancer among women, with an incidence rate of 25.5%,

followed by cervical cancer with a cancer incidence rate of 18.7%. Ovarian cancer has a CIR of 5.2%, while large bowel and corpus uteri cancers have Crude incidence rate of 3.9% and 3.7%, respectively (Dr. R. Swaminathan, n.d.). These figures highlight a significant burden on women health, particularly from breast and cervical cancers, suggesting a critical need for enhanced screening, early detection, and preventive measures to address these prevalent conditions effectively. Accurate projections of cancer incidence and mortality are needed for effective and efficient policy-making, accurate resource allocation, and to assess the impact of newly introduced policies and measures (Tudor, 2022). Therefore, this study aims to forecast the incidence of different gynaecological cancers in Tamil Nadu, which may optimise current policies, pave way for introduction of new policies or altering existing ones and may improve optimal resource allocation.

Objectives:

To illustrate the future trends in incidence of gynaecological malignancies for next 5 years in Tamil Nadu.

Operational definitions:

Other genital cancers includes endometrial cancer, vulval cancer and vaginal cancer.

Methods:

This study was conducted in Tamil Nadu from April to May 2024. It employs a secondary data analysis design to forecast trends in the incidence of gynaecological malignancies.

The incidence data for these cancers during the period from 2012 to 2021 will be sourced from the Tamil Nadu Cancer Registry Project (TNCRP) website. The forecasting will utilize ARIMA (Auto Regressive Integrated Moving Average) analysis. ARIMA's autoregressive (AR) component regresses the variable on its own lagged values, while the moving average (MA) component uses a linear combination of error terms from past values. The integrated (I) part of ARIMA involves differencing the data to achieve stationarity (Box et al., 2016). Data will be entered into MS Excel and analysed using the ARIMA module in Python to forecast future trends in cancer incidence. The outcome aims to provide a forecast of the incidence trends of gynaecological malignancies in Tamil Nadu, which may help to design future public health strategies and interventions.

Results:

In 2021, the incidence of new cancer cases in Tamil Nadu was as follows: breast cancer - 11,657, ovarian cancer - 2,287, cervical cancer - 6,668, and other genital cancers - 2,570.

Using ARIMA projections, a 30% increase in breast cancer cases is expected by 2030, reaching 15,155 cases (95% C.I. 12,795-17,515), as depicted in Figure 1. Ovarian cancer cases are projected to increase by 20%, totalling 2,746 cases (95% C.I. 2,295-3,197) as shown in Figure 2. Other genital cancers are expected to see a 48% rise, with an estimated 3,811 cases (95% C.I. 3,079-4,544) in 2030, as illustrated in Figure 3. Conversely, cervical cancer cases are projected to decrease by 1%, resulting in 6,737 cases (95% C.I. 4,542-8,933) by 2030, as shown in Figure 4. Overall, Figure 5 demonstrates an increase in the incidence of breast, ovarian, and other gynaecological cancers, with a slight decrease in cervical cancer cases.

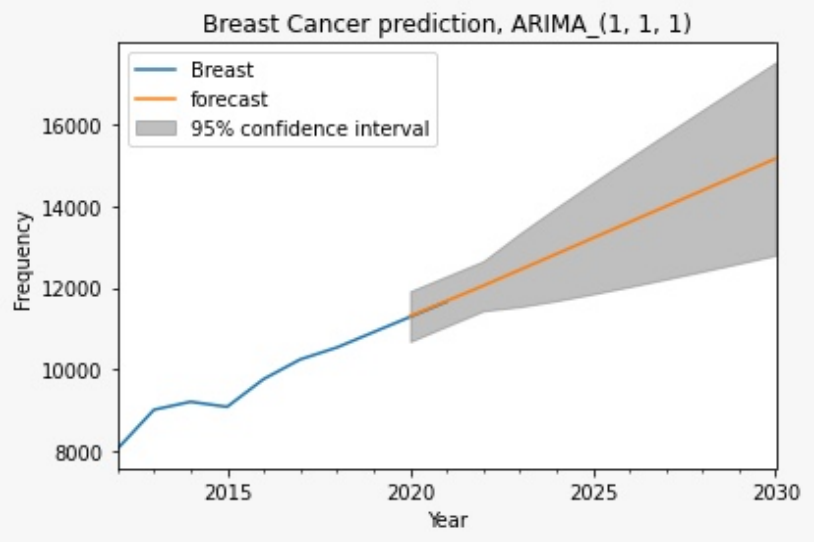

Figure 1: Projection of breast cancer

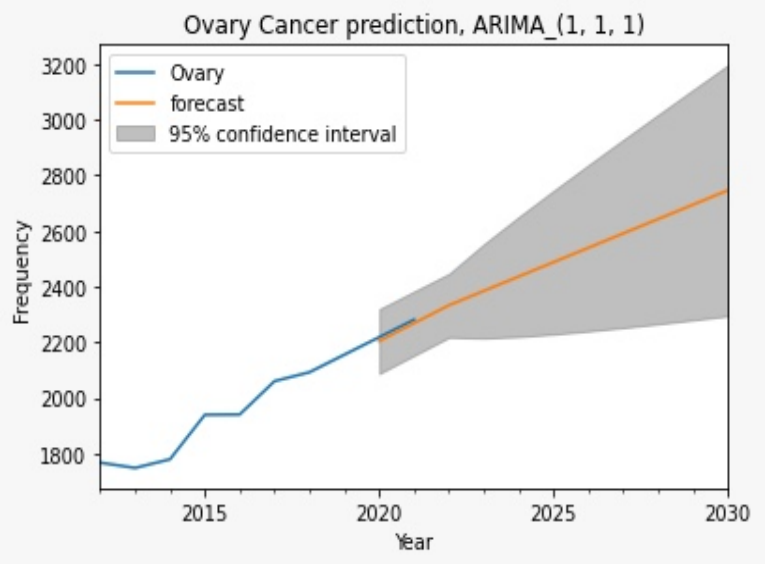

Figure 2: Projection of Ovarian cancer

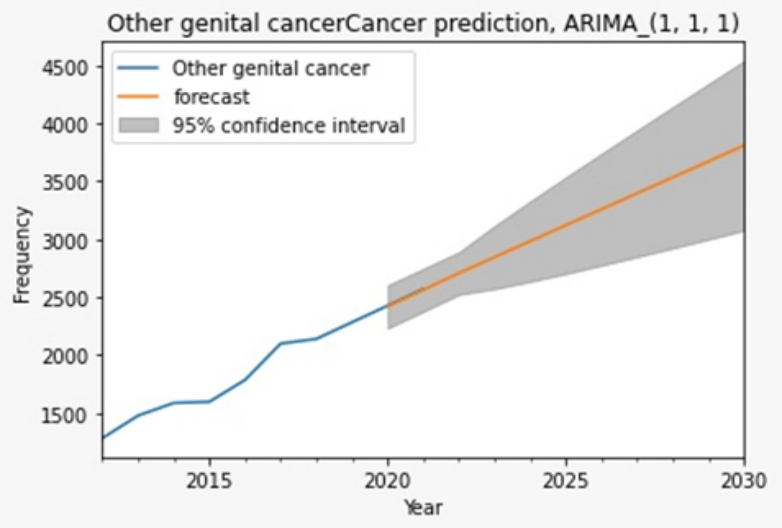

Figure 3: Projection of Other genital cancer

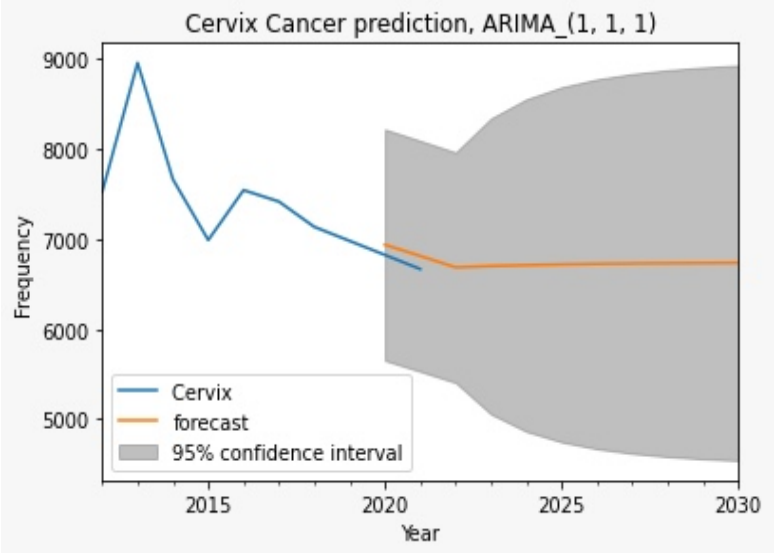

Figure 4: Projection of cervical cancer

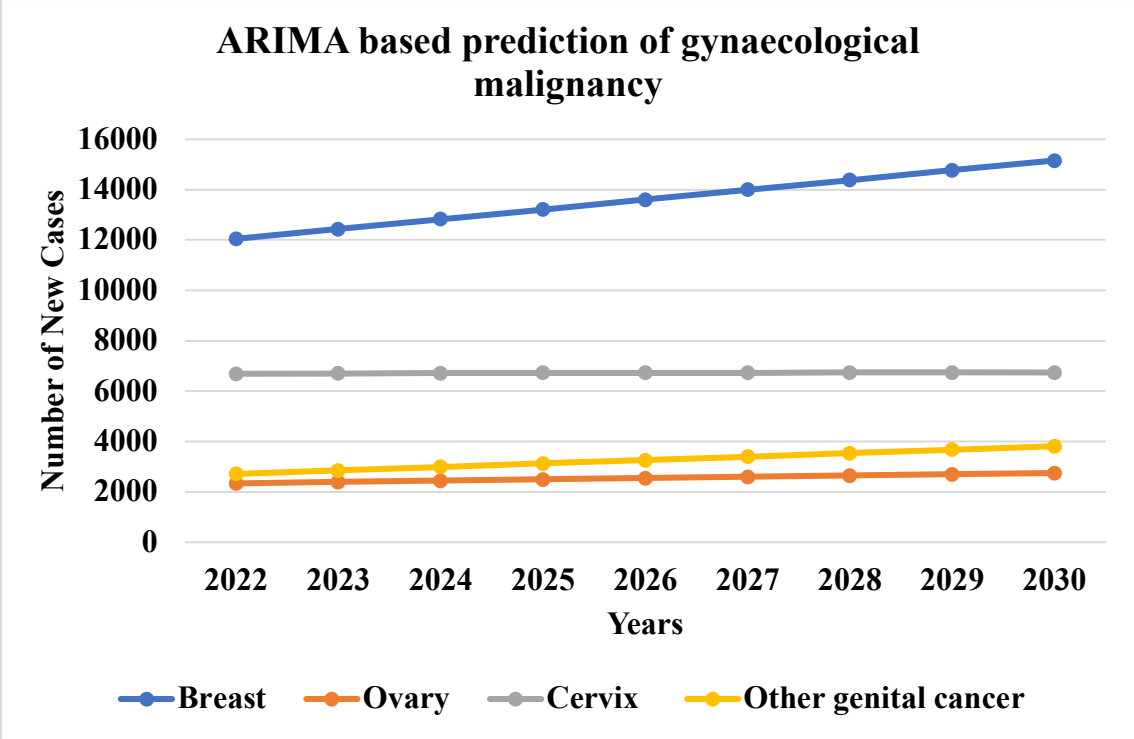

Figure 5: Overall projection of gynaecological malignancy in Tamil Nadu

Discussion:

The present study projects a significant increase in the incidence of breast cancer, ovarian cancer, and other genital cancers by 2030, while the incidence of cervical cancer is expected to slightly decrease which is similar to the findings of previous study (Rahib et al., 2021).

The global increase in breast cancer incidence can be linked to several factors such as aging population, adoption of Western lifestyle behaviours, and rising rates of premenopausal breast cancer in Asian countries (Sedeta et al., 2023) (Toi et al., 2023). Similarly, in Tamil Nadu, there is a notable rise in the ageing population and influence of western lifestyle are increasingly influencing dietary patterns (Kaviarasu et al., 2023) (Suganathan Soundararajan, 2017) (Kalusivalingam et al., 2020) (Odegaard et al., 2012). There is an increasing trend in ovarian cancers in India based on the study done by Nandagudi Srinivasa Murthy et (Murthy, n.d.) which is similar to the findings of our study. Smoking, obesity, and metabolic syndrome are linked to an increased risk of ovarian cancer.

Obesity, in particular, stands out as a significant risk factor, and the global rise in obesity rates is contributing to the growing incidence of ovarian cancer. Additionally, factors such as nulliparity (never having a full-term pregnancy), late menopause, and endometriosis further elevate the risk of developing ovarian cancer (Tanha et al., 2021) (Huang et al., 2022). There will be a huge increase in other genital cancers in Tamil Nadu in future which is in concordance with global trends (n.d.). Based on the 2020 report by ICMR-NCDIR, breast cancer and cervix uteri cancer are the most common cancer in India which is similar to the results of our studies (ICMR-NCDIR National Cancer Registry Programme estimates 12% increase in cancer cases in the country by 2025, 2020). Globally there is decreasing trend in cervical cancer among countries with high Human Development Index (Lin et al., 2021). This study also predicts a slight decrease in incidence of cervical cancer which may be due to change in Human Development Index of Tamil Nadu.

This study projects a significant increase in breast, ovarian, and other genital cancers in Tamil Nadu by 2030, alongside a slight decrease in cervical cancer incidence. Contributing factors include an ageing population, Western lifestyle adoption, and rising obesity rates. These trends align with global patterns, highlighting the need for targeted public health interventions and preventive measures.

Conclusion:

This study forecasts an increasing trend in hormone-related and lifestyle-related malignancies like breast, ovarian and other genital malignancies but a decreasing trend among infection-related cancer like cervical cancer in Tamil Nadu. This forecast may help in future introduction of new policies, optimize resource allocation and enhance current policies. This prediction can also be useful in generating awareness towards screening of gynaecological malignancies other than breast and cervical cancer

in future to tackle the change in the burden of disease.

Strengths: This study provides valuable predictions on the future trends in gynecological malignancies, which can be utilized for early planning and implementation of related policies and programs to address the anticipated disease burden.

Limitations: The study relies on historical data, and such trends may shift unexpectedly in the future due to unforeseen circumstances, potentially affecting the accuracy of the predictions.

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