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Research Article

The Diagnostic Yield of Multiphasic CT in Ovarian Cancer Staging among Women of Different Socioeconomic Strata

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ABSTRACT

Objective: To determine the diagnostic yield of multiphasic computed tomography (CT) in ovarian cancer staging among women of different socioeconomic strata.

Methods: This descriptive cross-sectional study was conducted at the Department of Obstetrics and Gynecology, Shaukat Omar Memorial Hospital, Fauji Foundation, from 1st April 2026 to 30 June 2026. A total of 153 women with suspected ovarian malignancy were enrolled through consecutive non-probability sampling. Demographic, clinical, and socioeconomic data were recorded using a structured proforma. Participants were categorized into low-, middle-, and high-income socioeconomic strata based on monthly household income. All patients underwent multiphasic contrast-enhanced CT of the abdomen and pelvis, and radiological staging was compared with the final surgical and histopathological findings, which served as the reference standard. Data were analyzed using SPSS version 28. Associations were assessed using the Chi-square test and one-way ANOVA, with $p \leq 0.05$ considered statistically significant.

Results: The mean age of participants was 52.8 ± 11.6 years. Serous epithelial carcinoma was the most common histopathological subtype (68.6%), while Stage III was the predominant FIGO stage (43.1%). Overall, 64.0% of women presented with advanced-stage disease (Stages III–IV). Multiphasic CT demonstrated a sensitivity of 93.6%, specificity of 50.0%, positive predictive value of 95.7%, negative predictive value of 40.0%, and an overall diagnostic accuracy of 90.2%. Diagnostic accuracy was significantly higher among women in the high socioeconomic stratum (97.1%) compared with the middle (91.8%) and low (84.5%) socioeconomic strata (p=0.033).

Conclusion: Multiphasic CT demonstrated high diagnostic accuracy for preoperative ovarian cancer staging. Socioeconomic status was significantly associated with diagnostic performance, highlighting the need for equitable access to timely diagnostic imaging to optimize staging and treatment planning.

Keywords: Ovarian Cancer, Multiphasic Computed Tomography, Diagnostic Accuracy, Figo Staging, Socioeconomic Status, Histopathology.

INTRODUCTION

Ovarian cancer is among the deadliest gynecological malignancies, largely because it is clinically silent in its early stages and therefore often caught only when it has already spread beyond the pelvis. By themselves, symptoms of abdominal bloating, pelvic discomfort, early satiety, and urinary frequency are vague and nonspecific, leading to delays in diagnosis. As a result, almost 70% of women are diagnosed with advanced-stage disease, characterized by recurrence patterns and a prognosis that is significantly worse than early-stage tumors. Thus, preoperative staging is critical to assist with effective treatment planning, determination of surgical resectability, and to predict survival as well as quality of life. Imaging has turned into a central

aspect of this cycle, multiphase computed tomography (CT) being the essential technique for surveying infection level and recognizing metastatic involvement (1).

Ovarian cancer still poses a significant global health burden in the light of sophisticated diagnostic and treatment strategies. Ovarian cancer is one of the three most common malignancies worldwide and has a high fatality rate, with 1-year survival reaching as low as 30% due to poor early detection. It accounts for nearly 3.3% of cancers in women and still has an excessively high mortality-to-incidence ratio since most patients present with advanced disease. However, despite higher incidence rates in high-income countries, it is low- and middle-income parts of the world where mortality is particularly severe due to delayed diagnosis, lack of access to specialized imaging, and insufficient oncologic services that can further compromise patient outcomes (2).

Ovarian cancer is an important yet under-studied public health challenge in Pakistan. The latest estimates from GLOBOCAN show that the incidence of ovarian cancer in Pakistan is around 4700–5000 per annum, and deaths due to it are approximately 3500 yearly, which reflects its aggressive nature, coupled with poor diagnosis time. The majority of patients are diagnosed with FIGO stage III or IV disease, largely due to poor symptom recognition and long delays in presentation secondary to avoidance behaviours, financial issues, and limited access to appropriately-skilled healthcare practitioners. Low socioeconomic status may also hinder access to specialized imaging modalities, and there are several other barriers to diagnosis, such as delayed referrals or limited accessibility of dedicated gynecologic oncology services that would be expected to negatively modulate staging and treatment decisions (3).

Multiphasic CT has emerged as the standard imaging method for preoperative ovarian cancer staging as it can assess the primary tumor, peritoneal carcinomatosis, lymphadenopathy, and distant metastasis in one examination. Intravenous contrast improves the characterization of lesions and aids in determining whether the disease is resectable through arterial, portal venous, and delayed phase imaging. Diagnostic accuracy for advanced ovarian cancer spread (80% - 95%) information from previous publications in Europe, North America, and Asia, but the performance of imaging varies with imaging protocols employed, radiologist training, and availability of healthcare framework (4).

Although multiphasic CT of the abdomen is a common practice, there has been relatively little evidence assessing whether its diagnostic yield varies between socioeconomic classes, especially in developing countries like Pakistan. Most studies published to date have followed the performance of imaging alone without assessing the effect that socioeconomic inequalities may have on predictive results (5). It is well-established that there is inequitable access to health care resources, and as local data continue to be limited, it should be determined if an effect of socioeconomic status exists on the diagnostic performance of multiphasic chest CT in staging ovarian cancer. This kind of evidence may aid in identifying disparities in diagnostic pathways, supporting equitable allocation of resources, and advancing clinical decision-making for women with ovarian cancer. Thus, this study aimed to assess the diagnostic accuracy of multiphasic CT in staging women with ovarian cancer according to socioeconomic status.

MATERIALS AND METHODS

Study Design and Setting

This institution-based cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Shaukat Omar Memorial Hospital, Fauji Foundation, for a duration of Three months from 1st April 2026 to 30 June 2026. To assess the diagnostic yield of multiphasic computed tomography (CT) imaging in the staging of ovarian cancer among women across socioeconomic strata.

Sample Size Estimation

Sample size was calculated using the WHO Sample Size Calculator for the estimation of a single population proportion. We estimated the sample size based on 90% expected diagnostic accuracy of multiphasic computed tomography (CT) for staging ovarian cancer (6) with a 95% confidence level and a 5% margin of error; the minimum sample required was 139 patients. We calculated a final sample size of 153 patients, accounting for a 10% margin to account for potentially incomplete records and non-response.

Study Population

The study population consisted of female patients with clinically or radiologically suspected ovarian malignancy who underwent multiphasic contrast-enhanced CT for

preoperative staging during the period of study. Eligible patients were recruited consecutively following the signing of written informed consent. Exclusion criteria were recurrent ovarian cancer, prior chemotherapy or radiotherapy before imaging, incomplete imaging or clinical records, contraindications to iodinated contrast administration, and refusal to participate.

Data Collection Procedure

Demographic and clinical information were collected post-enrollment using a structured proforma. The variables collected were age, place of residence, education status, occupation, average monthly family income, symptoms at presentation, relevant investigations, cause for recurrence, and histopathological diagnosis. Socioeconomic strata were defined according to the study criteria based on household income per month. Multiphasic contrast-enhanced CT of the abdomen and pelvis was obtained in all patients as per the institutional imaging protocol. CT images were independently reviewed by multiple consultant radiologists who had no knowledge of the final histopathological results. The evaluation focused on the size and nature of the main ovarian mass, local tumor invasion, peritoneal implantations, omental involvement, lymphadenopathy, ascites; and distal metastases. CT findings were then correlated with intraoperative and histopathological staging, which was used as the reference standard for evaluating the diagnostic yield of CT.

Ovarian Cancer Staging

Staging of ovarian cancer was done according to the International Federation of Gynecology and Obstetrics (FIGO) 2018 staging system (7). Preoperative staging was initially performed with a multiphasic contrast-enhanced CT to assess the extent of the primary tumor, adjacent pelvic organ involvement, peritoneal dissemination, omental deposition, pelvic and para-aortic lymph node enlargement, ascites, and distant metastatic disease. The correlation between the radiological stage of disease (based on CT) was then compared with the final surgical and histopathological stage, which were taken as the gold standard.

Stage I disease was defined according to the FIGO 2018 classification as a tumor confined to one or both ovaries or fallopian tubes; Stage II, as tumor extension to pelvic organs below the pelvic brim; Stage III was growth outside of the pelvis by way of peritoneal spread and/or metastasis to retroperitoneal lymph nodes; and Stage IV as distant metastasis with extra-abdominal organ involvement or parenchymal metastases. Patients were classified according to the final FIGO stage, and the diagnostic yield of multiphasic CT was assessed through comparison of staging by CT and respective surgical-histopathological findings for statistical purposes.

Socioeconomic Stratification

Sociodemographic data were retrieved through participants' self-reported household monthly income obtained during the interview. Participants were divided into three socioeconomic strata based on the predefinitions of the study: low socioeconomic status (monthly household income PKR 100,000). Socioeconomic classification was undertaken before radiological assessment in order to avoid observer bias and enable comparison of the diagnostic yield of multiphasic CT between socioeconomic groups. This categorisation was performed for analytical purposes only; therefore, the oncological performance of multiphasic CT for ovarian cancer staging was assessed by means of socioeconomic status stratification.

Outcome Measures

The main outcome was the diagnostic yield of multiphasic computed tomography in the staging of ovarian cancer. Diagnostic performance was derived by comparing CT findings with final surgical and histopathological diagnosis, including the calculation of sensitivity (true positives vs. total pathology), specificity (true negatives vs. non-pathology), positive predictive values (no pathology to be considered radiologically), negative predictive values, and overall diagnostic accuracy, as well as computed through online calculators. Multiphasic CT diagnostic performance was also evaluated by socioeconomic status (SES).

Ethical Considerations

Approval from the Institutional Ethical Review Committee of Shaukat Omar Memorial Hospital, Fauji Foundation, for conducting the study was obtained prior to data collection. All participants provided (written) informed consent before being enrolled in the study. Unique identification numbers were given to each patient, and the data was accessed by members of the research team only; thus keeping patient information confidential at all

times throughout this study. All study procedures were performed according to the ethical principles of the Declaration of Helsinki.

Statistical Analysis

Data were entered, cleaned, and analyzed with SPSS version 28.0(IBM Corp., Armonk, NY, USA). Continuous variables were described either as mean ± standard deviation or median with interquartile range, depending on the data distribution, and categorical variables as frequencies and percentages. Multiphasic CT was assessed for its diagnostic performance using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy based on histopathological findings as the gold standard. Chi-square test or Fisher's exact test, where necessary, was used to assess the association between socioeconomic strata and diagnostic yield. In this study, $p < 0.05$ was considered statistically significant.

RESULTS

A total of 153 women with suspected ovarian malignancy who underwent multiphasic CT for preoperative staging were included in the study. The mean age was 52.8 ± 11.6 years, with most participants aged 51–60 years (35.9%). Overall, 37.9% belonged to the low, 39.9% to the middle, and 22.2% to the high socioeconomic stratum. Significant differences in baseline characteristics across socioeconomic groups were observed for residence (p=0.012) and educational status (p<0.001), whereas age, BMI, and marital status did not differ significantly (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics According to Socioeconomic Strata (n = 153)

Baseline & demographic parameters	Overall (n=153)	Low (n=58)	Middle (n=61)	High (n=34)	p-value
Age (years), Mean ± SD	52.8 ± 11.6	54.6 ± 10.9	52.4 ± 11.3	50.6 ± 12.5	0.238
Age Group (years)					0.281
≤40	23 (15.0)	6 (10.3)	10 (16.4)	7 (20.6)	
41–50	43 (28.1)	15 (25.9)	18 (29.5)	10 (29.4)	
51–60	55 (35.9)	23 (39.7)	22 (36.1)	10 (29.4)	
>60	32 (20.9)	14 (24.1)	11 (18.0)	7 (20.6)	
Residence					**0.012**
Urban	93 (60.8)	25 (43.1)	40 (65.6)	28 (82.4)	
Rural	60 (39.2)	33 (56.9)	21 (34.4)	6 (17.6)	
Weight (kg), Mean ± SD	66.4 ± 11.2	64.3 ± 10.8	66.8 ± 11.0	69.2 ± 11.8	0.083
Height (m), Mean ± SD	1.59 ± 0.07	1.58 ± 0.06	1.59 ± 0.07	1.60 ± 0.07	0.412
BMI (kg/m²), Mean ± SD	26.3 ± 4.8	25.7 ± 4.5	26.4 ± 4.7	27.2 ± 5.1	0.289
BMI Category					0.356
Underweight	9 (5.9)	5 (8.6)	3 (4.9)	1 (2.9)	
Normal weight	56 (36.6)	24 (41.4)	21 (34.4)	11 (32.4)	
Overweight	58 (37.9)	20 (34.5)	25 (41.0)	13 (38.2)	
Obese	30 (19.6)	9 (15.5)	12 (19.7)	9 (26.5)	
Marital Status					0.447
Married	127 (83.0)	46 (79.3)	52 (85.2)	29 (85.3)	
Unmarried	11 (7.2)	5 (8.6)	4 (6.6)	2 (5.9)	
Widowed	12 (7.8)	6 (10.3)	4 (6.6)	2 (5.9)	
Divorced	3 (2.0)	1 (1.7)	1 (1.6)	1 (2.9)	
Educational Status					**<0.001**
No formal education	39 (25.5)	25 (43.1)	12 (19.7)	2 (5.9)	
Primary	35 (22.9)	18 (31.0)	13 (21.3)	4 (11.8)	
Secondary	47 (30.7)	12 (20.7)	23 (37.7)	12 (35.3)	
Higher secondary	18 (11.8)	2 (3.4)	8 (13.1)	8 (23.5)	
Graduate or above	14 (9.2)	1 (1.7)	5 (8.2)	8 (23.5)	

Data are presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. Continuous variables were compared using one-way analysis of variance (ANOVA), while categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05was considered statistically significant.

Histopathological examination showed that serous epithelial ovarian carcinoma was the predominant subtype (105, 68.6%), followed by mucinous (23, 15.0%), endometrioid (14, 9.2%), and clear-cell carcinoma (11, 7.2%). The distribution of histopathological subtypes varied significantly across socioeconomic strata (p=0.041). Furthermore, Stage III was the most common FIGO stage (66, 43.1%), and 64.0% of patients presented with advanced-stage disease (Stages III–IV) (Figure 1).

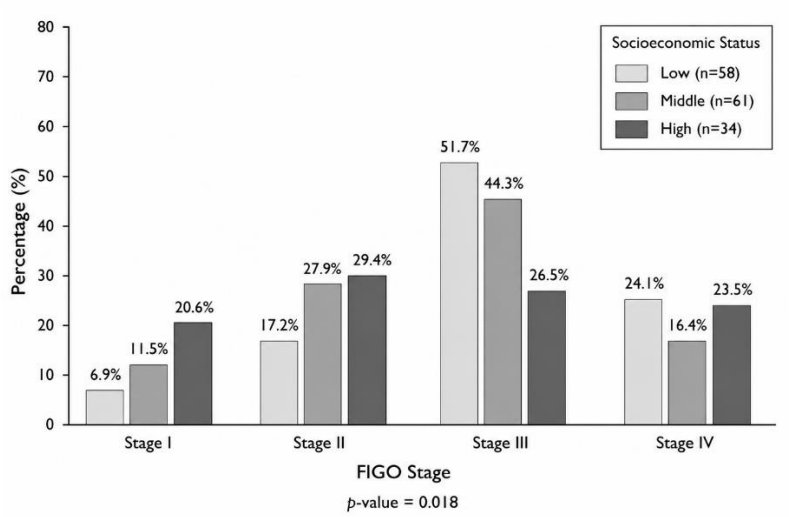

Figure 1. Histopathological SUBTYPe According to Socioeconomic Strata (n = 153)

According to the final histopathological staging based on the FIGO classification, Stage III disease was the most common presentation, observed in 66 (43.1%) women, followed by Stage II in 37 (24.2%), Stage IV in 32 (20.9%), and Stage I in 18 (11.8%). Advanced-stage disease (Stages III–IV) was more frequently observed among women belonging to the low socioeconomic stratum than those in the middle- and high-income groups, and this association was statistically significant (p=0.018) (Table 2).

Table 2 Distribution of FIGO Stage According to Socioeconomic Strata (n = 153)

FIGO Stage	Overall n (%)	Low n (%)	Middle n (%)	High n (%)	p-value
Stage I	18 (11.8)	4 (6.9)	7 (11.5)	7 (20.6)	
Stage II	37 (24.2)	10 (17.2)	17 (27.9)	10 (29.4)	
Stage III	66 (43.1)	30 (51.7)	27 (44.3)	9 (26.5)	
Stage IV	32 (20.9)	14 (24.1)	10 (16.4)	8 (23.5)	**0.018**

Data are presented as frequency (percentage). Comparisons between socioeconomic strata were performed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Comparison of multiphasic CT findings with the final surgical and histopathological diagnosis demonstrated that CT correctly staged 138 of 153 patients, resulting in an overall diagnostic accuracy of 90.2%. Histopathology identified 141 patients with advanced-stage disease, of whom 132 were correctly classified by CT. Nine patients were understaged, whereas six were overstaged by CT (Figure 2).

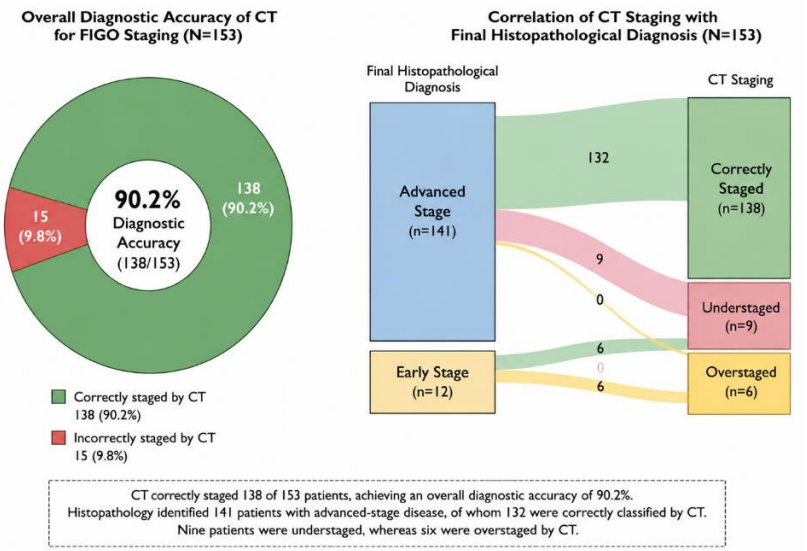

Figure 2. Comparison of Multiphasic CT Staging with Final Histopathological Staging

The diagnostic performance of multiphasic CT demonstrated a sensitivity of 93.6%, specificity of 50.0%, positive predictive value of 95.7%, negative predictive value of 40.0%, and an overall diagnostic accuracy of 90.2% (Table 3).

Table 3. Diagnostic Performance of Multiphasic CT in Ovarian Cancer Staging

Parameter	Value (%)
Sensitivity	93.6
Specificity	50.0
Positive Predictive Value	95.7
Negative Predictive Value	40.0
Overall Diagnostic Accuracy	90.2

Histopathology was considered the reference standard. PPV = positive predictive value; NPV = negative predictive value.

The diagnostic accuracy of multiphasic CT differed significantly according to socioeconomic status. Women in the high socioeconomic stratum demonstrated the highest diagnostic accuracy (97.1%), followed by those in the middle socioeconomic stratum (91.8%) and the low socioeconomic stratum (84.5%). The association between socioeconomic status and diagnostic accuracy was statistically significant ($\chi^2 = 6.82$, $p = 0.033$), suggesting that socioeconomic differences may influence the diagnostic yield of multiphasic CT in ovarian cancer staging (Table 4).

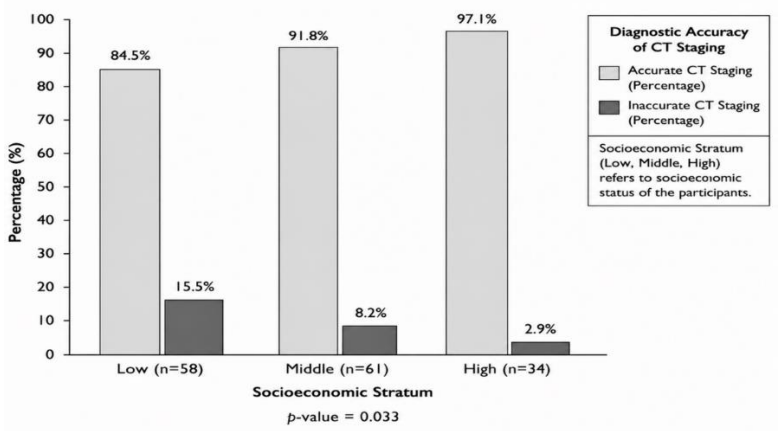

Figure 3. Association between Socioeconomic Strata and Diagnostic Accuracy of Multiphasic CT

DISCUSSION

This study was performed to analyse the diagnostic yield of multiphasic computed tomography (CT) in the staging of ovarian cancer affecting women from diverse socio-economic strata. The results showed a very high overall accuracy of multiphasic CT (90·2%), with excellent sensitivity (93·6%) and positive predictive value (95·7%) for preoperative staging. In addition, higher socioeconomic status was associated with a more accurate diagnosis, providing evidence that the diagnostic evaluation of women with ovarian cancer varies by socioeconomic status.

The mean age of the participants was 52.8 ± 11.6 years, and most of the patients were between 51 and 60 years old. Multiple previously conducted studies from Pakistan and other countries showed similar age at the time of ovarian cancer diagnosis (8, 9). Increased incidence in this age group is not surprising, as causative genetic alterations accumulate over time, hormonal changes associated with menopause, and increasing exposure to environmental and reproductive risk factors (10).

In our study, serous epithelial carcinoma was the most common histopathological subtype and comprised 68.6% of all cases. These results are consistent with the dated information from a Pakistani tertiary care hospital about the most common epithelial ovarian malignancy being serous carcinoma (11). Very similar findings have been reported in international studies from Europe, North America, and East Asia, where serous carcinoma is consistently found to account for about two-thirds of all ovarian cancers (12, 13). The predominance of this subtype may be explained by its aggressive biological behavior, occasional origin in the distal fallopian tube (the so-called 'serous tubal intraepithelial carcinoma' or STIC), as well as a propensity for advanced stage at presentation. The great heterogeneity in histopathological subtype by socioeconomic strata in this analysis may represent differences in/in access to care, community awareness, and/or time-to-clinical presentation.

Most women in the current study were diagnosed with FIGO Stage III disease, and almost two-thirds presented with advanced-stage disease (Stages III–IV). Similar trends have been reported from Pakistan (14), where delayed diagnosis continues to be one of the key challenges due to inadequate recognition of symptoms, prolonged referral, and restricted access to specialized gynecologic oncology services. Similar trends have been reported from other low- and middle-income countries (15, 16). In comparison, studies from developed countries reported relatively , higher frequencies of early disease due to better health awareness and referral pathways, cancer multidisciplinary care, and availability of advanced diagnostic imaging (17, 18). This study reveals that the potential for earlier diagnosis of disease at an earlier stage is impacted by socioeconomic inequalities, with a dramatically higher proportion of women in the lower socioeconomic group diagnosed at advanced stages.

In our study, we have observed that multiphasic CT has excellent diagnostic performance in staging ovarian cancer. The sensitivity of 93.6% and overall diagnostic accuracy of 90.2% seen are consistent with other studies, which describe a range in the diagnostic accuracy for optimal preoperative staging being between 85%-95% in women with OC (19). Multiphasic CT has also been shown in studies by Forstner et al (20) and Zhu Y et al (21), along with several international studies, to accurately stage ovarian malignancy, identifying peritoneal metastases, lymph node involvement, omental disease, and distant metastases. Differences in reported diagnostic performance across the studies are likely explained by differences in CT acquisition protocols, scanner technology, and possible reporter variation that generate the reports of the scans.

The strong correlation between diagnostic test accuracy and socioeconomic profile was a major finding from the current study. In terms of diagnostic accuracy, women of the high socioeconomic stratum had the highest (97.1%), and women of the low socioeconomic stratum had the lowest (84.5%), respectively. International studies, despite being fewer in number from Africa and South America, assessing the association of socioeconomic disadvantage with presentation delay, access to advanced imaging means, health literacy, and lower referral patterns for specialized cancer services have been well established (22-24). The reasons for this could be more advanced disease, suboptimal imaging quality or delayed investigations which finally impacts on diagnostic performance. Our findings underscore the importance of evaluating socioeconomic disparities in conjunction with imaging advancements to better stage ovarian cancer.

CONCLUSION

The results of this investigation provide more evidence to support the use—where applicable—of multiphasic CT as a suitable preoperative imaging modality in patients with ovarian cancer, while underscoring the need for policy initiatives focused on reducing socioeconomic inequalities that may hinder access to diagnostic resources and thereby impact clinical outcomes. Larger multicenter studies are needed to confirm these findings and investigate strategies to facilitate equitable access to high-quality diagnostic imaging.

Conflict of Interest: The authors declare no conflict of interest.

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