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Ministry of Health Data Reveals Age, Gender, and Clinic-specific Differences in CEA Test Outcomes for Colorectal Cancer Detection

Şuayıp Birinci

Republic of Turkiye, Ministry of Health

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ABSTRACT

Objective: Carcinoembryonic antigen (CEA) is a tumor marker associated with various malignancies, including colorectal cancer. This study analyzes the use and outcomes of CEA testing in Türkiye, with a focus on colorectal cancer detection. The objective of this study is to examine the values of CEA in Türkiye, how it is used in cancer diagnosis and treatment, and how it can be optimized.

Methods: Data from a five-year period (2017-2021) were analyzed, including a total of 27,394,778 tests from 4,016,178 individuals. The CEA test results were obtained through immunoassay method and extracted from the National Health Database System of the Turkish Ministry of Health.

Results: The study found that the number of CEA tests and the number of tests per 100,000 population increased progressively between 2017 and 2019, followed by a decrease in 2020 and 2021. The rate of tests exceeding the reference range was highest in the over-65 age group and in men. The study also found that the number of CEA tests requested was highest in the Marmara region and Central Anatolia region and lowest in the Southeastern Anatolia region.

Conclusion: This study provides valuable insights into the application and outcomes of CEA tests in the detection of colorectal cancer across various demographic groups in Türkiye. Despite its limitations, this study reveals gender, age, and clinic-specific disparities in test application and outcomes, and underscores the potential value of CEA as a biomarker in cancer detection. Future research should aim for a more comprehensive data collection that encompasses lifestyle and genetic factors, longitudinal tracking of individuals in order to capture disease progression, and to explore additional biomarkers for colorectal cancer.

Keywords: Carcinoembryonic antigen, colorectal cancer, health data

ORCID IDs of the author: Ş.B. 0000-0001-8104-6198.

Corresponding Author: Şuayıp Birinci,
E-mail: drbirinci@gmail.com

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INTRODUCTION

Carcinoembryonic antigen (CEA) is a type of tumor marker associated with many types of cancer and some nonmalignant conditions. First identified in 1965 by Dr. Phil Gold and Dr. Sam Freedman, CEA is typically a glycoprotein found on the surface of cancerous cells. It shows an increase in many malignancies, including colorectal, stomach, pancreatic, lung, and breast cancers (1).

It is a glycoprotein with a molecular weight of 200 kDa and is normally derived from embryonic endodermal epithelium in the fetus, controlled by fetal oncogenes. It usually disappears from serum after birth; however, small quantities of CEA may remain in colon tissue. CEA and related genes (29 of which 18 are normally expressed) constitute the CEA family in human beings and are clustered on chromosome 19q13.2 (2). Because it is associated with various types of malignant and nonmalignant medical conditions, elevated serum CEA levels are not a definitive marker of a particular site of cancer origin (3).

CEA is a tumor marker used in colorectal, stomach, esophageal adenocarcinoma, non-small-cell lung cancer, and breast cancer. CEA is the tumor marker with the highest value in the follow-up of patients with colorectal cancer and its use is recommended in international guidelines (4).

Various meta-analyses highlight that CEA plays a significant role in the early detection of relapse in patients diagnosed with colorectal cancer, subsequently having positive effects on survival. CEA is also a preferred marker in the evaluation of treatment response and the early detection of progression in patients with metastatic disease. A continuous increase above the basal CEA value suggests disease progression, even in the absence of confirmatory imaging methods (5).

Given Türkiye population, access to healthcare, and efforts in cancer diagnosis and treatment, the development of a database related to the use of CEA is significant. The establishment of this database can enhance the quality of health services in Türkiye. Moreover, this database could play a critical role in providing more information on how CEA can be better utilized in cancer treatment.

This study aims to examine the values of CEA in Türkiye, how it is used in cancer diagnosis and treatment, and how it can be optimized. This study will also explore how the broader use of CEA could affect patients in Türkiye.

This introduction will discuss efforts to understand the use of CEA in Türkiye based on a comprehensive literature review, extensive data collection, and analysis. It will also corroborate how this study could contribute to cancer treatment by identifying possible directions and issues for future research.

METHODS

Data from a five-year period (2017-2021) were analyzed, including a total of 27,394,778 tests from 4,016,178 individuals. The test counts, test rates per population, and rates of exceeding the reference range were assessed based on gender, age groups, geographic regions, and healthcare institution types.

The CEA test results were obtained through immunoassay method and extracted from the data transferred to the National Health Database System of the Turkish Ministry of Health. The healthcare database service in Türkiye is referred to as e-Nabiz. The transmission of health data set packages is facilitated through XML web services. This database encompasses the health records of patients who have sought medical services from all public, private and university healthcare institutions in Türkiye. The data include all the demographic characteristics, laboratory data, medication usage, and comorbidities of these patients.

Database and E-pulse

E-pulse is a platform developed by the Ministry of Health in Türkiye. It allows individuals to store and manage their health information digitally. For this study, patient information and health records were collected from the e-Pulse system. During the data collection process, personal information was protected, and the principle of privacy was fully respected.

This platform allows users to use 30 different services for prevention, treatment, health promotion, and health-related areas. In addition, some statistics belonging to the relevant categories are also included in the e-pulse system (6).

Health Coding Reference Server (HCRS) and International Classification of Disease (ICD) Codes

HCRS is a data recording and reporting system used by the Ministry of Health in Türkiye. This system aids in the more effective management of health services. In this study, data pulled from the HCRS, and ICD codes were used to analyze disease diagnoses, treatment plans, and the overall state of health services. ICD codes are a standard disease and health problem classification system created by the World Health Organization and used worldwide. These codes are an important tool for identifying, monitoring, and treating diseases.

The study population: The study population consisted of individuals who underwent CEA testing during the study period. Both men and women were included in the analysis.

Statistical Analysis

Descriptive statistics were used to analyze the data. The test counts, test rates per population, rates of exceeding the reference range, and cancer diagnosis rates were calculated and compared across different variables, including gender, age groups, geographic regions, and healthcare institution types.

Ethical considerations: The study adhered to ethical guidelines and protected the privacy and confidentiality of the individuals included in the data. Institutional review board approval was obtained, and all data were anonymized to ensure the privacy of the individuals involved in this study.

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RESULTS

Between 2017 and 2021, CEA testing was requested from 4,016,178 individuals with the total number of tests amounting to 27,394,778. This results in an average of 6.82 tests per individual and 33,150 tests per 100,000 population. Among the tumor markers used in our CEA study, it holds the highest test number per 100,000 population. When comparing the number of CEA tests year by year, the number of tests and the number of tests per 100,000 population increased progressively between 2017 and 2019, followed by a noticeable decrease in 2020 and 2021 (Table 1). For women, the pattern is similar. The number and rate of requested tests increased from 2017 to 2019 and then significantly decreased in 2020 and 2021. It ranks sixth among all tumor markers tested in women across all years. In men, the test request pattern mirrors that of the general population, with the number and rate of tests increasing progressively from 2017 to 2019 and decreasing noticeably in 2020 and 2021. Comparing the number of tests for women to men year by year, the ratio was 2.01 in 2017, 2.01 in 2018, 2.03 in 2019, 1.96 in 2020 and 1.96 in 2021. When examining the rates of exceeding the reference range by gender, it was found to be positive at a rate of 12.82% overall, 18.01% in men and 10.14% in women. In men, the rate of exceeding the reference range for tests is second (Table 2).

When comparing test request numbers across different age groups, CEA was most frequently requested in the 18-64 age group, followed by the over-65 age group, and was least requested in the 0-17 age range. The ratio of test requests between the 18-64 age group and the over-65 group was 2.46 in 2017, 2.43 in 2018, 2.35 in 2019, 2.37 in 2020 and 2.25 in 2021. The consumption ratio of tests per 100,000 individuals between the 18-64 age group and the over-65 group was 1/2.99 in 2017, 1/2.96 in 2018, 1/2.96 in 2019, 1/2.79 in 2020 and 1/2.94 in 2021. Among the over-65 group, CEA was the second most requested tumor marker per 100,000 individuals.

Between 2017 and 2019, as the years progressed, both the number of test requests and the consumption per 100,000 individuals in the over-65 group increased, but there was a significant decrease in 2020 and 2021. When examining the rates of exceeding the reference range by age group, it was found to be the highest at 18.56% in those over 65, second at 10.44% in the 18-64 age group, and third at 1.20% in the 0-17 age group. When compared by the age group, a positivity ratio of 15.4/8.7/1 was found. When examining the rates of exceeding the reference range by admission status, the highest rate is 17.25% for inpatients, 16.22% for day-case patients, and 12.30% for outpatient patients; when rated in order, a ratio of 1.40/1.31/1 is calculated (Table 3).

In the Ministry Health's e-Nabiz and Sina data, among the 4,016,178 individuals examined for CEA within 27,39,778 tests, significant differences were found in terms of age and gender when evaluated using the chi-square test for association and

Table 1. Number of tests and the ratio of the population by years

	2017		2018		2019		2020		2021	
CEA	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population
	5,124,970	6,342	5,915,615	7,214	6,531,332	7,854	4,757,144	5,689	5,065,717	6,058

CEA: carcinoembryonic antigen

Table 2a. Number of test requests in women by years

	2017		2018		2019		2020		2021	
CEA	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population
	3,423,742	8,501	3,955,933	9,681	4,379,233	10,569	3,153,069	7,562	3,357,328	8,051

CEA: carcinoembryonic antigen

Table 2b. Number of test requests in men by years

	2017		2018		2019		2020		2021	
CEA	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population	Number of tests	Number of tests per 100,000 population
	1,701,228	4,197	1,959,682	4,763	2,152,095	5,158	1,604,075	3,827	1,708,388	4,076

CEA: carcinoembryonic antigen

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additional assessment among those who were not tested for CEA (p<0.0001) (Table 4).

When comparing the rate of receiving a cancer diagnosis at any time in patients who were tested for the CEA tumor marker, the cancer detection rate increased as the years progressed from 2017 to 2020. In 2017, 36% of individuals, in 2020, 47% of individuals, and in 2021, 42% of individuals received a cancer diagnosis. When comparing cancer detection rates in people who were tested for tumor markers, CEA ranks second in terms of diagnostic percentage in all years. When analyzing the timing of test requests for individuals tested for tumor markers at the time of diagnosis, it was found that requests were at most predominantly made before diagnosis, second at the same time as diagnosis, and least frequently after diagnosis. The rate of pre-diagnosis test requests increased as the years progressed up to 2020, with a rate of 16.64% in 2017 and 37.67% in 2020, dropping to 34.41% in 2021. When examining the rates of exceeding the reference range for tests based on whether a cancer diagnosis has been made, a total of 12.84% of individuals tested positive, 20.16% of the positive patients had a cancer diagnosis, and 5.48% did not have a cancer diagnosis (Table 5).

In 2017, 7.20% of the individuals who had a CEA test received a CEA-related cancer diagnosis, while 37.73% received a CEA-unrelated cancer diagnosis. These rates increased until 2020, when 9.34% of patients received a CEA-related cancer diagnosis, and 49.73% received a CEA-unrelated cancer diagnosis. In 2021, these rates were 8.50% and 45.19% respectively. When comparing those who received a CEA-related cancer diagnosis with those who received a CEA-unrelated cancer diagnosis, the ratio was 1/5.24 in 2017, 1/5.27 in 2018, 1/5.30 in 2019, 1/5.32 in 2020, and 1/5.31 in 2021.

The CEA test was most frequently requested in the Marmara region across all years. It was second most frequently requested in the Central Anatolia region, with a ratio of 1.65 between the two regions in 2021. The region with the least test requests in all years was the Southeastern Anatolia region. When comparing the top region (Marmara) with the bottom region (Southeastern Anatolia) in 2021, the ratio was 11.64. As in the rest of Türkiye, the number of test requests increased from 2017 to 2019 in all regions except Southeastern Anatolia, and there was a significant decrease in test requests from 2020 to 2021 (the decrease in Southeastern Anatolia started in 2019). When analyzing the number of tests per 100,000 population across regions, the Central Anatolia region had the highest request rate across all years. The region with the lowest request rate across all years is Southeastern Anatolia. In 2021, when comparing the highest test rate region of Central Anatolia with the second-highest, Marmara, the ratio was 1.16. When compared with the lowest region, Southeastern Anatolia, the ratio was 4.81. When examining the rates of exceeding the reference range by geographical region, the highest rate belonged to the Aegean region, which ranked third in all years for test requests and tests per 100,000 population, at 15.4%. The Mediterranean region, which had the second lowest test per 100,000 population from 2019 to 2021, was second with 13.6%, and the Black Sea

Table 3. Test consumption per 100,000 persons by years and age groups

	2017			2018			2019			2020			2021		
CEA	0-17	18-64	65+	0-17	18-64	65+	0-17	18-64	65+	0-17	18-64	65+	0-17	18-64	65+
	215	7,080	21,214	239	8,007	23,730	247	8,623	25,534	148	6,284	17,583	149	6,589	19,434

CEA: carcinoembryonic antigen

Table 4a. Relationship between CEA status and gender group

	Men	Women	Total	p-value
CEA non-requested	77.4%	22.6%	100.0%	0.0001
CEA requested	33.9%	66.1%	100.0%	
Total	64.0%	36.0%	100.0%	

CEA: carcinoembryonic antigen; chi-squared test

Table 4b. Relationship between CEA status and age group

	0-17	18-64	65+	Total	p-value
CEA non-requested	1.7%	66.1%	32.2%	100.0%	0.0001
CEA requested	0.8%	69.3%	29.9%	100.0%	
Total	1.4%	67.1%	31.5%	100.0%	

CEA: carcinoembryonic antigen; chi-squared test

Table 5. Distribution of cancer diagnosis related to CEA

Year	Related cancer diagnosis		Non-related cancer diagnosis		Total number of people tested
2017	75,049	7.20%	393,440	37.73%	1,042,719
2018	87,176	7.29%	459,697	38.46%	1,195,399
2019	95,019	7.35%	503,707	38.97%	1,292,611
2020	88,433	9.34%	471,002	49.73%	947,186
2021	89,720	8.50%	477,209	45.19%	1,056,044

CEA: carcinoembryonic antigen

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region was third with 12.9%. The lowest rate belonged to the Eastern Anatolia region, which had the second lowest number of test requests, at 10.5% (Table 6).

When provinces were analyzed based on the number of test requests, İstanbul was the city with the highest number of test requests across all years, followed by Ankara. Bursa and İzmir were all in the third place. Looking at the number of tests per 100,000 population, Sinop had the highest number in 2017, Erzurum in 2018, Kırşehir in 2019, and Isparta in 2020 and 2021. Ankara, which has the highest number of test requests, is not in the top 7 cities.

When clinics were compared based on the number of test requests, the clinic requesting the most tests was Internal Medicine in 2017-2018 and Medical Oncology in 2019-2021. The second most frequent were Medical Oncology and Internal Medicine, and the third was Obstetrics and Gynecology. General surgery ranked 4th, while gastroenterology ranked 5th. Family medicine ranked 7th in 2017-2019 and 2021, and emergency medicine ranked 8th in the same years.

When examining the rate of tests exceeding the reference range in clinics requesting CEA tests, the highest rate is 22.07% in the Medical Oncology clinic; this is followed by 12.92% in the Hematology clinic; and the third is 12.60% in the Emergency Medicine clinic. The rate in the Internal Medicine clinic, which was the highest in terms of test request numbers in 2017-2018, is 8.49%, the rate in the Medical Oncology clinic, which was the highest in 2019-2021, is 22.07% (second), and the rate in the Obstetrics and Gynecology clinic, which was third in all years, is 2.81% (the lowest rate in the top ten clinics). Family medicine had the second lowest rate among the 10 clinics (Table 7).

When the rates of exceeding the reference range were compared by years, the highest rate was in 2020 at 14.40%, and the lowest rate was in 2017 at 11.81%. Among tumor markers, CEA has the third highest rate of exceeding the reference range.

When the rates of exceeding the reference range were compared by institution tier, the highest rate was at tertiary institutions at 13.72%, secondary institutions were second at 11.31%, and primary institutions were third at 6.19%. When examining the rates of exceeding the reference range by institution type, the total rate was 12.83%, with university hospitals having the highest rate at 15.10% while private health institutions ranked second at 14.76%, and public hospitals third at 11.04%.

DISCUSSION

Our study provides a comprehensive analysis of various aspects related to CEA test requests, distribution, and outcomes across different demographics, regions, and clinical contexts within Türkiye. It has identified several disparities and patterns, offering crucial insights into the use of this particular biomarker in healthcare landscape. From the geospatial distribution of test requests, demographic-specific test outcomes to institutional variables and financial implications, the results contribute to the growing body of evidence surrounding CEA testing. These findings invite discussion on a variety of fronts including the practice of diagnostic testing, interpretation of results, allocation of healthcare resources, and the role of disease-specific contexts in driving these trends. Let us delve deeper into these areas to understand the implications of these results and their potential impact on the healthcare system.

The geographical disparity in the demand for CEA tests across different regions of Türkiye, specifically the high demand in Central Anatolia and the low demand in Southeastern Anatolia, illuminates the uneven distribution of healthcare resources across the country, raising important questions about the accessibility and availability of diagnostic testing. Furthermore, changes in the demand for CEA tests among different clinics, particularly the shift from Internal Medicine to Medical Oncology over the years, hint at evolving disease patterns and a growing focus on oncology.

Table 6. CEA geographical distribution by years and test per 100,000 population

2017		2018		2019		2020		2021	
Marmara region	7,496	Central Anatolia region	8,728	Central Anatolia region	9,989	Central Anatolia region	7,216	Central Anatolia region	8,151
Eastern Anatolia region	7,341	Marmara region	8,407	Marmara region	9,192	Marmara region	6,680	Marmara region	6,993
Central Anatolia region	7,156	Aegean region	7,656	Aegean region	8,334	Aegean region	6,444	Aegean region	6,826
Aegean region	7,105	Eastern Anatolia region	7,389	Eastern Anatolia region	7,479	Black Sea region	5,450	Black Sea region	5,901
Black Sea region	6,323	Black Sea region	7,172	Black Sea region	7,314	Eastern Anatolia region	4,878	Eastern Anatolia region	5,193
Mediterranean region	4,519	Mediterranean region	5,789	Mediterranean region	6,551	Mediterranean region	4,669	Mediterranean region	4,768
Southeast Anatolia region	2,406	Southeast Anatolia region	2,671	Southeast Anatolia region	2,578	Southeast Anatolia region	1,728	Southeast Anatolia region	1,694

CEA: carcinoembryonic antigen

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Table 7. CEA top 10 clinics by years and number of test requests

2017		2018		2019		2020		2021	
Internal medicine	1,165,988	Internal medicine	1,292,526	Medical oncology	1,469,374	Medical oncology	1,426,489	Medical oncology	1,339,452
Medical oncology	979,236	Medical oncology	1,235,601	Internal medicine	1,364,917	Internal medicine	846,849	Internal medicine	999,363
Gynecology and obstetrics	812,500	Gynecology and obstetrics	914,926	Gynecology and obstetrics	994,944	Gynecology and obstetrics	661,358	Gynecology and obstetrics	697,154
General surgery	678,596	General surgery	740,201	General surgery	739,870	General surgery	493,935	General surgery	513,263
Gastroenterology	317,402	Gastroenterology	367,268	Gastroenterology	359,896	Gastroenterology	270,256	Gastroenterology	308,765
Radiation oncology	216,422	Radiation oncology	247,889	Radiation oncology	250,914	Radiation oncology	153,949	Radiation oncology	149,572
Family medicine	110,356	Family medicine	159,380	Family medicine	186,530	Emergency medicine	100,433	Family medicine	118,395
Emergency medicine	78,214	Emergency medicine	88,076	Emergency medicine	129,557	Family medicine	93,819	Emergency medicine	93,486
Chest diseases	63,096	Neurology	67,930	Neurology	82,088	Gynecological oncology	62,207	Gynecological oncology	78,929
Urology	60,225	Urology	67,134	Gynecological oncology	79,668	Neurology	56,111	Neurology	65,644

CEA: carcinoembryonic antigen

The higher rates of CEA test results exceeding the reference range among males and individuals above 65 indicate the potential impact of demographic factors on disease prevalence. Observations regarding the high rates of abnormal CEA levels among inpatients and outpatient daycare patients suggest a possible correlation between disease severity and elevated CEA levels. Lastly, the steady trend observed in Türkiye Health Practice Communiqué and unit costs over the years calls for a discussion on the efficiency and financial implications of current testing practices. This comprehensive analysis offers valuable insights for shaping future healthcare policies and practices.

Colorectal cancer is the third most common type of cancer, with about 1.5 million cases diagnosed worldwide each year, according to GLOBOCAN 2018 data. Approximately 750,000 patients have been lost due to this disease. The incidence rate of colon cancer per 100,000 people is 35.7 for men and 29 for women (7).

While colorectal carcinoma is more commonly seen in men, our study found that the number of tests requested for women has been higher in all years when the female-to-male test number ratio is considered: 2.01 in 2017, 2.01 in 2018, 2.03 in 2019, 1.96 in 2020, and 1.96 in 2021. When we looked at the rates of tests exceeding the reference range by gender, we generally found a positive rate of 12.82%, with 18.01% in men and 10.14% in women. In men, the rate of tests exceeding the reference range ranks second.

Age is the most important risk factor for sporadic colorectal cancer as it is rarely seen under the age of 40, and the incidence increases from 40 to 50 years onward. 90% of cases are seen in patients over the age of 50, and this rate is 10% in men and 15% in women over the age of 80. The risk of colorectal cancer increases with age, and in the period of 2015-2019, individuals were divided into age groups with 5-year intervals. The incidence of colorectal cancer in each age group increases by 80-100% for every 5-years up to the age of 50, and by 20-30% for every 5-years in those aged 55-59 and above (8). In our study, when the number of test requests per year was compared by age group, CEA was most frequently requested in the 18-64 age group, second most frequently in the over 65 age group, and least frequently in the 0-17 age range.

CEA is the tumor marker with the highest value in the follow-up of patients with colorectal cancer, and its use is recommended in international guidelines. The general opinion in the guidelines is that CEA monitoring should be performed after surgery. When the test request times at the time of diagnosis for individuals who had tumor markers requested were analyzed in our study, it was found that in all years, the tests were mostly requested before the diagnosis, second most frequently at the same time as the diagnosis, and least frequently after the diagnosis (9).

In Zhang et al. (10), the specificity rate of CEA in colorectal diagnosis was calculated as 91%. In another study by Ding et al. (11) in 2022, the sensitivity was calculated as 70.59%.

In our study, 7.20% of the individuals who underwent the CEA test in 2017 received a CEA-related cancer diagnosis and 37.73% received a CEA-unrelated cancer diagnosis. There has been an

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increase in these rates up to 2020, with 9.34% of patients receiving a CEA-related cancer diagnosis and 49.73% receiving a CEA-unrelated cancer diagnosis. In 2021, these rates are seen at 8.50% and 45.19%, respectively. When the rates of tests exceeding the reference range are compared by year, the highest rate is in 2020 at 14.40%, and the lowest rate is in 2017 at 11.81%. Among tumor markers, it ranks as the third highest marker in terms of the rate of exceeding the reference range. When the rates of tests exceeding the reference range are compared by institutional level, the highest rate is in tertiary institutions, followed by secondary and primary institutions. When examining the rates of tests exceeding the reference range by institution type, the total rate was 12.83%, with the highest rate in university hospitals, followed by private health institutions, and finally public hospitals.

While this study provides valuable insights into the prevalence and detection of colorectal cancer, it also exposes certain limitations that should be addressed in future research. These include the risk of selection bias due to reliance on available medical records and performed tests, a lack of consideration for lifestyle and genetic factors influencing colorectal cancer incidence, and the cross-sectional nature of the study that limits understanding of disease progression. Also, the heavy reliance on CEA as a biomarker may mask the full picture due to its known limitations in specificity and sensitivity. Consequently, future research should aim for a more comprehensive data collection that encompasses lifestyle and genetic factors, longitudinal tracking of individuals to capture disease progression, exploration of additional biomarkers for colorectal cancer, ensuring sample representativeness to mitigate selection bias, and considering disparities in healthcare access that could impact test requests and diagnosis rates.

Study Limitations

This study has several limitations. First, the data were obtained retrospectively, which means that pre-study design control could not be implemented. Additionally, there may be missing or erroneous data in the dataset. The scope of the study focused solely on the use of the CEA test and did not consider the impact of other potential factors or variables.

CONCLUSION

This study contributes valuable insights into the application and outcomes of CEA tests in the detection of colorectal cancer across various demographic groups. It reveals gender, age and clinic-specific disparities in test application and outcomes, highlights the prevalence of CEA tests conducted before cancer diagnosis, and underscores the potential value of CEA as a biomarker in cancer detection despite its limitations. Although there are challenges due to potential selection bias, lack of comprehensive information on influencing factors, and constraints of the cross-sectional study design, the findings shed light on critical areas for future research and policymaking. These include a need for more nuanced approaches to testing strategies, further exploration of potential biomarkers, and consideration of broader contextual factors in colorectal cancer detection and treatment. Ultimately, these insights have significant implications for improving colorectal cancer detection strategies, enhancing patient outcomes, and advancing the field of cancer research.

Ethics Committee Approval: The study adhered to ethical guidelines and protected the privacy and confidentiality of the individuals included in the data. Institutional review board approval was obtained, and all data were anonymized to ensure the privacy of the individuals involved in this study.

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

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