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Effects of Demographic and Socio-Economic Factors on Investigation Time of Lung Cancer Patients in Denmark: A Retrospective Cohort Study

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Abstract

Background: Lung cancer is one of the most common cancer types worldwide. The significance of the individual socio-economic position on the delay in lung cancer diagnosis has not been properly investigated. The purpose of this nationwide population-based study is to examine the association between position and the length of the primary investigation for lung cancer.

Materials and Methods: This register study was based on all lung cancer patients in Denmark who were diagnosed in 2012 to 2017, in total 28,431 patients. We used a multivariate logistic regression model and multivariate zero-inflated negative binomial model to estimate the effect of education level, family income, difficulty of transport, and cohabitation status on the length of the primary investigation.

Results: We found that the patients' income, difficulty of transport, and cohabitation status were associated with the length of the primary investigation. The chance of carrying out the investigation process within 24 days is higher for patients with a high income (adjusted OR = 0.86 with 95% CI (0.81; 0.91)), lower for patients with troublesome transport (adjusted OR = 0.67 with 95% CI (0.61; 0.72)), and lower for patients living alone (adjusted OR = 0.93 with 95% CI (0.88; 0.99)).

Conclusion: Several socio-economic factors are associated with the length of the primary lung cancer investigation. To ensure that all patients receive the most appropriate health care and to avoid extra investigation time, clinicians may pay extra attention to patients who are less fortunate due to low income, troublesome transport to the hospital, or living alone.

Keywords

lung cancer, logistic regression, investigation time, socio-economic factor, longevity

Background

Lung cancer is one of the most common cancer types worldwide. In 2022, lung cancer has become the most frequent and lethal cancer in Denmark, with almost 4000 people dying annually.[1] In general, the lung cancer prognosis is poor with a 5-year survival of approximately 18%[2] it accounts for 1.76 million deaths worldwide per year.[3] The 5-year survival rate for patients with metastatic non-small cell lung cancer is close to zero[4] and median overall survival after standard first-line treatment is only 7 to 10 months.[4,5] Several studies show that socio-economic deprivation is associated with reduced survival and lower treatment rate.[6,7]

The Danish healthcare system provides free and equal access to cancer treatment for all patients, but socio-economic deprivation still has a significant effect on cancer survival and access to treatment.[8–10]

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A few studies have examined the effect of the socio-economic position on lung cancer treatment using Danish data, but they focused primarily on cancer survival.[11,12] Patients' socio-economic position may also have an impact on the quality of the diagnostics and treatment and the time to diagnosis and treatment.[13–15] To address this, the Danish National Board of Health has launched cancer care pathways, in which the maximum time interval for the primary investigation is defined.[16] The underlying pattern of how socio-economic position can influence the length of primary investigation may be complex and include a combination of factors. Bringing these factors into focus will help to identify vulnerable lung cancer patients who benefit from extra support.

Methods

Aim and Design

The purpose of this nationwide population-based retrospective study is to investigate whether the time length of the primary investigation for lung cancer is longer for patients with a low position than for patients with a high socio-economic position.

Data

Using the Danish Lung Cancer Registry (DLCR) we identified patients who were diagnosed with lung cancer in the period 2012 to 2017. Since 2000, the DLCR[17] has monitored and evaluated the quality of treatment of all registered Danish patients with lung cancer. All departments involved in the diagnosis and treatment of lung cancer in Denmark participate in DLCR and are responsible for the validation and supplementation of data. The database contains data describing the patients' characteristics, the diagnosis and treatment procedures, comorbidity, and survival.

Using a unique civil registration number the patient's data from DLCR was linked to the Income Statistics Register[17,18] to obtain information on the patient's cohabitation status, income, place of residence, and the highest level of education at the time of the cancer diagnosis.

Variables Definitions

Exposure. We defined four factors related to the person's socio-economic position: (i) education, (ii) income, (iii) transport to the primary investigating or treating hospital, and (iv) cohabitation status.

The variable *education* is defined as "short" if the patient's highest level of completed education corresponds to primary school and "high" if the patient's highest level of completed education is higher than primary school. Income is calculated using the family income in the year the patient was diagnosed with lung cancer, adjusted for the number of persons in the household. Variable *income* is defined as low and high by the median. Transport to the primary investigating or treating hospital is calculated using information about the distance from the patient's place of residence to the primary investigating or treating hospital and the duration time for transport from the patient's place of residence to the primary investigating or treating hospital. Variable *transport* is defined as easy if the distance is less than 150 km and the duration is less than one and a half hours and difficult if otherwise. The patient's cohabitation status is defined as *living with a partner*, irrespective of marital status, or *living alone*. Information about a person's family status was included in the Danish central register in 2013, so all analyses for that exposure were performed only on patients who were diagnosed with lung cancer in the period 2013 to 2017.

Outcome. In 2009, The Danish National Board of Health established the cancer care pathways. The cancer care pathways state that the time length of the primary investigation should not exceed 24 days. Therefore, the primary outcome measurement of this study is defined as the *primary investigation time* constructed as 0 if the time interval does not exceed 24 days and 1 if otherwise. The start of the primary investigation is defined as the date of referral to the investigation (date of diagnosis) and the end of the primary investigation is defined as the date of the treatment decision. The second outcome measurement that was investigated in this study was defined as the *primary investigation in days.* The variable is constructed as a count variable indicating the number of days from start to end of the primary investigation.

Potential Confounders. We defined the following possible confounder variables. *Age*, low age is younger than 70 years, which is the mean age for the patient population, and high age is older than the mean age for the patient population. *Sex*, as female versus male. Pathology, as NSCLC for patients with non-small cell lung cancer and SCLC for patients with small cell lung cancer. *Clinical tumor stage* in four groups (I–IV) according to the TNM classification. *Comorbidity* was calculated using the Charlson comorbidity index (CCI) on comorbidity records 5 years prior to the lung cancer diagnosis: 0 as CCI score of 0 and 1 as CCI score bigger than 0.[20] *Alcohol misuse*, as yes if the patient has had alcohol-related diagnoses within 5 years prior to lung cancer and otherwise as no.[19] *Psychiatric disorders*, as yes if the patient has had at least one diagnosed psychiatric disorder within 5 years prior to lung cancer, and otherwise as no. Performance score (PS): 0 as PS score of 0, 1 as PS score of 1, and 2 as PS score >1.

Statistical Analyses

The following analyses will be performed separately for different factors of socio-economic status.

We calculated the proportions of persons for whom the *primary investigation time* does not exceed 24 days, for the exposed and unexposed cohorts. Logistic regression models were used to estimate the effect of vulnerable socio-economic factors on the *primary investigation time*. To estimate the effect of vulnerable socio-economic factors on the count outcome variable: *primary investigation in days,* we fitted a

zero-inflated negative binomial models.[21] All analyses performed using STATA version 17.0

Results

A total number of 28,431 patients were registered in the DLCR and were examined primarily within the study period from 2012 to 2017. Table 1 includes descriptive information on all patients who had completed the primary examination.

Descriptive Analyses

Of the study population, we had information about education on 27,741 patients.

About 38% of these patients had a long education. Approximately 54% of the patients with a short education and only 35% of the patients with a long education were younger than 70 years at the time of lung cancer diagnosis. More than 55% of the patients with a short education were women and only 40% were women among the patients with a long education. More than 58% of the study population had a high income. 56% among those were younger than 70 years at the time of lung cancer diagnosis whereas only 35% among the patients with low income were younger than 70 years at the time of lung cancer diagnosis. Fewer patients with a high income had a high PS (35% of patients with a high income had a PS > 1 vs 45% of patients with a low income) and fewer patients with a high income had comorbidity (52% of patients with a high income vs 62% of patients with a low income). A total number of 13,186 patients were not living alone, whereas 10,507 patients were living alone at the time of lung cancer diagnosis. Data showed that more patients older than 70 years were living alone (57% of patients living alone were older than 70 years vs 51% of patients not living alone). More women were living alone (60% of patients living alone were women vs 42% of patients not living alone). More patients living alone had a high PS (44% of patients living alone had a PS > 1 vs 34% of patients not living alone). More patients living alone had alcohol misuse (3% of patients living alone vs 1% of patients not living alone) and more patients living alone had a psychiatric diagnosis (4.5% of patients living alone vs 1.6% of patients not living alone). Only 3819 (13%) patients of the study population had difficult transport. Apparently, fewer patients with difficult transport had an advanced tumor stage, 43% of patients with difficult transport had a tumor stage equal to IV versus 48% of patients with easy transport.

Model-Based Analysis

The results of the logistic regression analysis for estimating the effect of vulnerable factors on the *primary investigation time* are illustrated in Table 2. Estimates from adjusted analyses showed that the level of education does not affect performing lung cancer examination within 24 days (estimated odds ratio (OR) = 1.05 with 95% confidence interval (CI) (0.99; 1.11)). We found that the chance of carrying out the investigation process within 24 days is significantly higher for patients with a high income (adjusted OR = 0.86 with 95% CI (0.81; 0.91)). Both adjusted and crude analyses showed that troublesome transport was significantly connected to a lower chance of carrying out the investigation process within 24 days (adjusted OR = 0.67 with 95% CI (0.61; 0.72)). Estimates from the adjusted analysis showed a small and borderline negative significant effect of living alone status on the chance to carry out the examination process within 24 days (adjusted OR = 0.93 with 95% CI (0.88; 0.99)).

Estimates of the effect of vulnerable social factors on the count outcome variable—*primary investigation in days*—confirm the results from the logistic regression analyses (see Table 2). Estimates from the adjusted analysis showed that the investigation process took fewer days for patients with a high income and that the investigation process took significantly fewer days for patients who had easy transport to the investigation hospital. The estimated effects of education and cohabitation status are not significant.

Discussion

The goal of this study was to investigate whether the socio-economic position of lung cancer patients influenced the length of the primary examination for lung cancer. We investigated the effect of four socio-economic factors: education, income, troublesome transport to the investigating hospital, and cohabitation status. We found that the vulnerable patients at risk for having prolonged time of the primary examination were characterized by having low income, living alone, and being far from the hospital. This study provides updated evidence of patient-related factors that may influence the length of the primary examination.

We did not find an association between education level and the primary examination, which is a line with some previous studies.[22,23] However, research conducted in Bangladesh[24] and India[25] suggested that high educational level was associated with shorter primary examination intervals. This could be because of a different definition of education groups, in Denmark 9 years of school education is mandatory, so we consider 9 years of education as low, whereas the population in Bangladesh has a low literacy level and more than 5 years of education is considered as high.

In agreement with previous studies,[24,26] we observed that income vulnerability has a negative effect on the length of the primary examination, even after adjusting for confounders associated with income. It means that for patients with a low income, it takes a longer time from the start of the investigation process to the decision on treatment, compared to that for patients with a high income. A possible explanation could be differences in communication between patients and healthcare professionals.[27]

Previous studies[28,29] have shown that patients with low SEP did not engage actively in consultations and did not receive the same degree of information on treatment. Limited health literacy will make considerations of potential benefits and harms of treatment more difficult, and thus cause a delay to treatment.

Table 1. Study Populations' Baseline Characteristics by Factors Related to the Person's Position.

	Education		Income		Living alone		Transport	
	Short	Long	Low	High	Alone	Not alone	Difficult	Easy
N	17,182 61.9%	10,559 38.1%	11,846 41.6%	16,585 58.3%	10,507 44.3%	13,186 55.7%	3819 13.4%	24,612 86.6%
Age								
<70 years	9317 (54.2%)	3706 (35.1%)	4075 (34.4%)	9255 (55.8%)	4484 (42.7%)	6497 (49.3%)	1726 (45.2%)	11,604 (47.2%)
≥70 years	7865 (45.8%)	6853 (64.9%)	7771 (65.6%)	7330 (44.2%)	6023 (57.3%)	6689 (50.8%)	2093 (54.8%)	13,008 (52.8%)
Sex								
Women	9543 (55.5%)	4215 (40.0%)	6012 (50.8%)	8034 (48.4%)	6268 (59.7%)	5516 (41.8%)	1844 (48.3%)	12,202 (49.6%)
Men	7639 (44.5%)	6344 (60.0%)	5834 (49.3%)	8551 (51.6%)	4239 (40.3%)	7670 (58.2%)	1975 (51.7%)	12,410 (50.4%)
Year of diagnosis								
2012–2014	8309 (48.4%)	5293 (50.1%)	4985 (42.1%)	8995 (54.2%)	4136 (39.4%)	5138 (39.0%)	1787 (46.8%)	12,193 (49.5%)
2015–2017	8873 (51.6%)	5266 (49.9%)	6861 (57.9%)	7590 (45.8%)	6371 (60.6%)	8048 (61.0%)	2032 (53.2%)	12,419 (50.5%)
Cancer stage								
I	3105 (18.1%)	1954 (18.5%)	2200 (18.6%)	2992 (18.0%)	1926 (18.8%)	2504 (19.0%)	805 (21.1%)	4387 (17.8%)
II	1305 (7.6%)	799 (7.6%)	923 (7.8%)	1222 (7.4%)	772 (7.4%)	1031 (7.8%)	370 (9.7%)	1775 (7.2%)
III	3377 (19.7%)	1907 (18.1%)	2248 (19.0%)	3159 (19.1%)	1975 (18.8%)	2527 (19.2%)	782 (20.5%)	4625 (18.8%)
IV	8118 (47.3%)	5066 (48.0%)	4162 (37.6%)	7914 (47.7%)	4976 (47.4%)	6270 (47.6%)	1632 (42.7%)	11,873 (48.2%)
Missing	1277 (7.4%)	833 (7.9%)	884 (7.5%)	1298 (7.8%)	858 (8.2%)	854 (6.5%)	230 (6.0%)	1952 (7.9%)
Performance score								
0	5758 (33.5%)	3432 (32.5%)	3216 (27.2%)	6160 (37.1%)	2906 (27.7%)	5057 (38.4%)	1253 (32.8%)	8123 (33.0%)
1	4795 (28.0%)	2974 (28.2%)	3352 (28.3%)	4610 (27.8%)	2932 (27.9%)	3601 (27.3%)	1105 (28.9%)	6857 (27.9%)
≥2	6629 (38.6%)	4153 (39.3%)	5278 (44.6%)	5815 (35.1%)	4669 (44.4%)	4528 (34.3%)	1461 (38.3%)	9632 (39.1%)
Alcohol misuse								
No	16,805 (97.8%)	10,396 (98.5%)	11,578 (97.7%)	16,294 (98.3%)	10,196 (97.0%)	13,047 (99.0%)	3758 (98.4%)	24,114 (98.0%)
Yes	377 (2.2%)	163 (1.5%)	268 (2.3%)	291 (1.8%)	311 (3.0%)	139 (1.0%)	61 (1.6%)	498 (2.0%)
CCI								
0	7830 (45.6%)	4348 (41.2%)	4520 (38.2%)	7962 (48.0%)	4273 (40.7%)	6053 (45.9%)	1704 (44.6%)	10,778 (43.8%)
≥1	9352 (54.4%)	6211 (58.8%)	7326 (61.8%)	8623 (52.0%)	6234 (59.3%)	7133 (54.1%)	2115 (55.4%)	13,834 (56.2%)
Pathology								
NSCLC	13,792 (80.3%)	8561 (81.1%)	9349 (78.9%)	13,547 (81.7%)	8319 (79.2%)	10,881 (82.5%)	3083 (80.7%)	19,813 (80.5%)
SCLC	2515 (14.6%)	1429 (13.5%)	1758 (14.8%)	2267 (13.7%)	1483 (14.1%)	1847 (14.0%)	590 (15.5%)	3435 (14.0%)
Missing	875 (5.1%)	569 (5.4%)	739 (6.2%)	771 (4.7%)	705 (6.7%)	458 (3.5%)	146 (3.8%)	1364 (5.5%)
Psychiatric diagnosis								
No	16,601 (96.6%)	10,326 (97.8%)	11,452 (96.7%)	16,140 (97.3%)	10,034 (95.5%)	12,970 (98.4%)	3753 (98.3%)	23,839 (96.9)
Yes	581 (3.4%)	233 (2.2%)	394 (3.3%)	445 (2.7%)	473 (4.5%)	216 (1.6%)	66 (1.7%)	773 (3.1%)

Table 2. Distribution of Outcome Measurements by Vulnerability Factors and Results of Regression Analyses.

	Education		Income		Transport		Living alone	
	Short	Long	Low	High	Difficult	Easy	Yes	No
Investigation time								
≤24 days	10,898 (63.4%)	6525 (61.8%)	7205 (60.8%)	10,633 (64.1%)	1751 (45.9%)	15,770 (64.1%)	6420 (61.1%)	8117 (61.6%)
>24 days	6284 (36.6%)	4034 (38.2%)	4641 (39.2%)	5952 (35.9%)	2068 (54.2%)	8842 (35.9%)	4087 (38.9%)	5069 (38.4%)
Crude OR	1.07 (1.02, 1.13)		0.87 (0.83, 0.91)		0.66 (0.62, 0.71)		0.98 (0.93, 1.03)	
Adjusted OR	1.05 (0.99, 1.11)		0.86 (0.81, 0.91)		0.67 (0.61, 0.72)		0.93 (0.88, 0.99)	
Investigation time in days								
Median (25%; 75%)	20 (13;28)	20 (14; 28)	20 (13;29)	20 (13; 28)	22 (16; 30)	20 (13;28)	20 (13; 28)	20 (14;28)
Crude IRR	1.02 (1.01; 1.04)		0.97 (0.96;0.98)		0.89 (0.88; 0.91)		1.01 (0.99; 1.03)	
Adjusted IRR	1.02 (1.00; 1.03)		0.97 (0.95; 0.98)		0.91 (0.89; 0.93)		0.99 (0.98; 1.01)	

We also found that patients who had a troublesome transport to the investigating hospital had a prolonged length of the primary examination. There may be several reasons for the extended investigation time. This could be the patient's wish to postpone some investigating procedures because it could be complicated for the patient to arrange transport to the hospital, or it could be difficult for accompanying persons to find time to escort the patient. It is also possible that low income is associated with troublesome transport. Other studies found that long distance to the hospital and trouble transport to the hospital is associated with low assess to treatment, which support our results.[30,31]

The last finding of our study indicates that patients who are socially vulnerable because they live alone wait longer from the start of the primary investigation to the decision on treatment. The effect that patients who are living alone wait longer for treatment could reflect of lack of a support person who can support the cancer patient and who can help to understand and accept treatment consequences.[32]

Strengths and Limitations

We used exclusively register data for this study. The strength of using register data is the completeness of the study populations and independently collected data, which minimizes the selection bias. Moreover, data from DLCR is validated by clinicians, which practically eliminates printing errors in the data. As a limitation, it could be mentioned that we used data from 2012 to 2017 for the study. To the best of our knowledge, no administrative changes have been introduced within the last few years that could affect, which means that the results of our study can be generalized to the present time. Other limitation of our study is that we investigated only four factors related to the socio-economic position. We find it less likely, but cannot rule out, that patients who are vulnerable due to other socio-economic factors could experience longer primary investigation time and longer time from the end of the primary investigation to treatment for lung cancer than not vulnerable patients experiences.

Availability of Data and Material

The data that support the findings of this study are available from Statistics Denmark (dst@dst.dk) but restrictions apply to the availability of these data, which were used under license for the current study. Data were analyzed on Statistics Denmark's remote server.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval and Consent to Participate

No ethical approval was required (assessed by The Regional Committees on Health Research Ethics for Southern Denmark, journal number 20192000-27). The study is approved by the Danish Data Protection Agency and listed on the records of personal data processing activities at the data controller, The Region of Southern Denmark (file no. 18/22336).

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References

1. The Danish Cancer Society. Report: Kræft i Danmark. The Danish Cancer Society; 2022. Available from: http://www.cancer.dk.
2. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2021;71(3): 209-249.
3. Thai AA, Solomon BJ, Sequist LV, et al. Lung cancer. *Lancet.* 2021;398(10299):535-554.
4. Bjørnhart B, Mouritzen MT, Kristiansen C, et al. 5-Year survival in Danish patients with advanced non-small cell lung cancer

treated with immune checkpoint inhibitor monotherapy. *Acta Oncol.* 2023; 62(8):861–870.
5. Redondo-Sánchez D, Petrova D, Rodríguez-Barranco M, et al. Socio-economic inequalities in lung cancer outcomes: An overview of systematic reviews. *Cancers (Basel).* 2022;14(2):398.
6. Polak M, Genowska A, Szafraniec K, et al. Area-based socio-economic inequalities in mortality from lung cancer and respiratory diseases. *Int J Environ Res Public Health.* 2019;16(10):1791.
7. Hajizadeh M, Johnston GM, Manos D. Socio-economic inequalities in lung cancer incidence in Canada, 1992-2010: Results from the Canadian Cancer Registry. *Public Health*. 2020;185:189-195.
8. Forrest LF, Sowden S, Rubin G, et al. Socio-economic inequalities in stage at diagnosis, and in time intervals on the lung cancer pathway from first symptom to treatment: Systematic review and meta-analysis. *Thorax.* 2017;72(5):430-436.
9. Engberg H, Steding-Jessen M, Øster I, et al. Regional and socioeconomic variation in survival after a pancreatic cancer diagnosis in Denmark. *Dan Med J.* 2020;67(2):A08190438.
10. Lejeune C, Sassi F, Ellis L, et al. Socio-economic disparities in access to treatment and their impact on colorectal cancer survival. *Int J Epidemiol*. 2010;39(3):710–707.
11. Finke I, Behrens G, Weisser L, et al. Socioeconomic differences and lung cancer survival-systematic review and meta-analysis. *Front Oncol*. 2018;8:536.
12. Dalton SO, Steding-Jessen M, Jakobsen E, et al. Socioeconomic position and survival after lung cancer: Influence of stage, treatment and comorbidity among Danish patients with lung cancer diagnosed in 2004–2010. *Acta Oncol.* 2015;54(5):797-804.
13. Tørring ML, Frydenberg M, Hansen RP, et al. Evidence of increasing mortality with longer diagnostic intervals for five common cancers: A cohort study in primary care. *Eur J Cancer*. 2013;49(9):2187-2198.
14. Richards MA. The national awareness and early diagnosis initiative in England: Assembling the evidence. *Br J Cancer*. 2009;101(S2):S1-S4.
15. Baldwin DR. Socioeconomic position and delays in lung cancer diagnosis: Should we target the more deprived? *Thorax*. 2017;72:393–395.
16. Christensen NL, Jekunen A, Heinonen S, Dalton SO, Rasmussen TR. Lung cancer guidelines in Sweden, Denmark, Norway and Finland: A comparison. *Acta Oncol*. 2017;56(7):943-948.
17. Jakobsen E, Rasmussen TR. The Danish lung cancer registry. *Clin Epidemiol*. 2016;8:537-541.
18. Pedersen CB. The Danish civil registration system. *Scand J Public Health.* 2011;39:22-25.
19. Thygesen LC, Daasnes C, Thaulow I, et al. Introduction to Danish (nationwide) registers on health and social issues: Structure, access, legislation and archiving. *Scand J Public Health*. 2011;39(7):12–16.
20. Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173(6):676-682.
21. Hilbe JM. *Negative binomial regression*. Cambridge University Press; 2011.
22. Bhosai SJ, Sinthusake T, Miwa S, et al. Factors affecting patient access in Thailand: Understanding delay in care seeking for patients with cancer. *Glob Public Health.* 2011; 6(4):385-397.
23. Olsen F, Jacobsen BK, Heuch I, et al. Equitable access to cancer patient pathways in Norway—A national registry-based study. *BMC Health Serv Res.* 2021;21(1):1272.
24. Ansar A, Lewis V, McDonald CF, et al. Factors influencing the timeliness of care for patients with lung cancer in Bangladesh. *BMC Health Serv Res*. 2023;23(1):261.
25. Garg A, Iyer H, Jindal V, et al. Evaluation of delays during diagnosis and management of lung cancer in India: A prospective observational study. *Eur J Cancer Care (Engl).* 2022;31(5): e13621.
26. Sachdeva R, Sachdeva S. Delay in diagnosis amongst carcinoma lung patients presenting at a tertiary respiratory centre. *Clin Cancer Invest J.* 2014;3(4):288-292.
27. Siminoff LA, Graham GC, Gordon NH. Cancer communication patterns and the influence of patient characteristics: Disparities in information-giving and affective behaviors. *Patient Educ Couns*. 2006;62:355-360.
28. Kaplan AL, Crespi CM, Saucedo JD, et al. Decisional conflict in economically disadvantaged men with newly diagnosed prostate cancer: Baseline results from a shared decision-making trial. *Cancer*. 2014;120:2721-2727.
29. Dencker A, Tjørnhøj-Thomsen T, Pedersen PV. A qualitative study of mechanisms influencing social inequality in cancer communication. *Psychooncology*. 2021;30:1965-1972.
30. Tataru D, Spencer K, Bates A, et al. Variation in geographical treatment intensity affects survival of non-small cell lung cancer patients in England. *Cancer Epidemiol*. 2018;57:13-23.
31. Crawford SM, Sauerzapf V, Haynes R, et al. Social and geographical factors affecting access to treatment of lung cancer. *Br J Cancer*. 2009;101:897-901.
32. Ahmad TR, Susko M, Lindquist K, et al. Socioeconomic disparities in timeliness of care and outcomes for anal cancer patients. *Cancer Med*. 2019;8(17):7186-7196.

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