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Correlation Between The Screening, Assessment Of Nutritional Status And Skeletal Metastasis In Non-Small Cell Lung Cancer (NSCLC)- A Retrospective Study

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ABSTRACT

Background: Lung carcinoma has developed over the past century from a rare and obscure disease to the most frequent cancer worldwide and the leading cause of cancer-related death. A collection of histological subtypes known as non-small cell lung cancer (NSCLC) affects about 85% of patients.

Aim: This study aims to determine the screening, correlating between the assessment of nutritional status and skeletal metastasis in non-small cell lung cancer, the prevalence, and the risk factors involved.

Methods: It was conducted at the Department of Medical Oncology, JSS Hospital, Agrahara, Mysuru from April to 30th June 2024 for 3 months involving 100 patients diagnosed with NSCLC.

Result: The prevalence rate of NSCLC in this study is higher in males than females in the age group 66-75 with more stages 3 and 4. Most patients obtained chemotherapy with anxiety, fatigue, breathlessness, and other symptoms. Diabetes and hypertension were seen as the most risk factors. BMI analysis showed a normal nutritional status in about 45-50% of patients, but screening and assessment showed a high risk of malnutrition and malnourishment. Skeletal metastasis is seen more in males than females.

Conclusion: From this study we understand that smoking habits play an important role in the progression of the disease as of male population is more addicted to it which impacts the prevalence rate in both males and females. Also, BMI alone can`t be used for the malnutrition analysis or nutritional status, screening and assessment test are must in assessing the patients. Decrease in nutritional status impacts higher in skeletal metastasis as the body loss its essential elements which impacts on the quality of life.

Keywords: *NSCLC, SGA, Screening, metastasis, anxiety*

1. INTRODUCTION

Lung carcinoma has developed over the past century from a rare and obscure disease to the most frequent cancer worldwide and the leading cause of cancer-related death.[1] A collection of histological subtypes known as non-small cell lung cancer affects about 85% of patients; the most prevalent subtypes are lung squamous cell carcinoma (LUSC) and lung adenocarcinoma (LUAD). While smoking is linked to all main histological subtypes of NSCLC and small cell lung cancer (SCLC), the correlation is higher for LUSC and SCLC than for LUAD, with the latter being the most prevalent histology in never-smokers.[2] Over the past few decades, there has only been a slight improvement in lung cancer survival rates. However, soon advances in targeted treatments and immunotherapy, as well as the availability of screening and early detection by low-dose CT, will probably result in lower death rates and better patient survival outcomes.[3]

Typically, lung malignancies are categorized as non-small cell lung cancer or small cell lung cancer. Approximately 15% of lung malignancies are malignant tumors called SCLCs, distinguished by their neuroendocrine characteristics. NSCLCs make up around 85% of all lung cancers, which comprise all lung cancer types besides small cell lung cancer. The two groupings' disparate histopathology, disease courses, and available treatments are reflected in this differentiation. Therefore, whether NSCLC classifications can successfully classify diverse tumor subtypes and directly associated treatment approaches is

unknown.[4] Lung cancer is the leading cause of cancer-related mortality, with an estimated 1.8 million deaths from the disease predicted worldwide in 2021.[5] The therapy paradigm for non-small cell lung cancer, which makes up 85% of all cases of lung cancer, has undergone significant change in the last ten years.[6] In a cohort study involving over 5000 individuals diagnosed with lung cancer between 1997 and 2002, over 60% were past smokers and only 25% were current smokers.[7] While smoking rates have decreased and peaked in the US and a few other places, in China and other developing nations, smoking rates have climbed significantly over the last 20 years but have not yet reached their peak. About two-thirds of Chinese males in their adult years smoke, making up about one-third of smokers globally.[8,9] Since smoking is the primary cause of lung cancer, it is thought to be a cancer that may be prevented. Comprehensive tobacco control programs report a decline in the incidence of lung cancer but an increase in the percentage of patients with non-small cell lung cancer who have never smoked.[10] In over half of cases, non-small cell lung cancers are discovered at an advanced stage.[11] Along with a significant symptom burden, patients with metastatic non-small cell lung cancer also have a poor quality of life. Less than a year is anticipated to be the prognosis.[12,13] Lung cancer is the leading cause of death in both men and women. It is a prevalent, rapidly spreading malignancy that is very aggressive. More people die from it each year than from the combined deaths from the following four main causes of cancer-related mortality. Its incidence and fatality rates are consistently correlated with at least 20 years of smoking history. A person's susceptibility to tobacco-induced lung cancer may depend on competitive gene-enzyme interactions that affect procarcinogen activation or detoxification, DNA adduct formation levels, and the integrity of endogenous DNA repair mechanisms.[14] The tumor, node, metastasis (TNM) staging system, which is kept up to date by the International Union Against Cancer (UICC) and the American Joint Committee on Cancer (AJCC), is the most widely used cancer staging system. The process of determining the primary tumor size and the amount of tumor dissemination inside the body is known as lung cancer staging. TNM staging provides patients with management offers prognosis and clinical trial eligibility data, and permits cross-national comparisons. The features of the primary tumor (T), the extent of lymph node involvement (N), and the existence or absence of metastases (M) determine the TNM staging.[15] NSCLC is a general term for a collection of primary lung tumors that make up 85–90% of all newly diagnosed lung and bronchus malignancies. These tumors include adenocarcinoma, squamous cell carcinoma, and large cell neuroendocrine carcinoma. The most prevalent type of NSCLC and lung cancer in general is adenocarcinoma accounts for 38% of newly diagnosed lung malignancies and almost 50% of NSCLC. Presently, squamous cell carcinoma is the second most prevalent non-small cell lung cancer, with a slowly declining frequency.[16] The prognosis and course of cancer patients' diseases are significantly influenced by their nutritional and immunological state. The prognostic nutritional index is a useful tool for evaluating the nutritional and immunological status of cancer patients. It is computed based on serum albumin levels and the total lymphocyte count in peripheral blood.[17] Loss in body weight (BW) is a typical clinical sign in cancer patients, particularly in those with advanced stages of the disease. Reduced physical function is typically linked to BW loss related to cancer, primarily as a result of muscle wasting. As a result, BW loss brought on by cancer may cause patients' general health to deteriorate as well as their performance status (PS) and quality of life (QOL). Furthermore, BW loss is a hallmark of cancer cachexia and a well-established prognostic marker in several malignant illnesses. According to Evans et al., cachexia is a metabolic syndrome marked by muscle loss with or without fat mass reduction and linked to underlying medical conditions.[18]

2. MATERIALS AND METHODS

This section aims to provide an overview of the protocols and techniques employed in the research. This research aims to determine the correlation between screening, assessment of nutritional status, and skeletal metastasis in NSCLC and also the prevalence and risk factors involved in it.

Research Design: This study was designed retrospectively because it allows a large number of samples to get involved in a particular period.

Participants: This study involved 100 patients who were diagnosed with Non-small Cell Lung Cancer and hospitalized. This study was conducted in the Department of Oncology, JSS Hospital, Mysuru during the period from April to June 2024, a duration of 3 months.

Data collection: A retrospective study that includes 100 patients who are diagnosed with non-small cell lung cancer in JSS Hospital, Agrahara, Mysuru. The data that was available in hospital medical records were collected which includes basic information- age, gender, stage of cancer, religion, socio-economic status, present and past medical history, signs and symptoms, anthropometric measurements, disease-related information, BMI, screening score, and assessment score, etc. Patients who had a performance scale ≥3 and on development of other malignancies were excluded. The study was accepted by the Institutional Ethics Committee of JSS Medical College, Bannimantap, Mysuru- 570015: JSSMC/IEC/130624/08 NCT/2024-25

Data Analysis Methods: Data analysis was done by descriptive statistics to summarise the data and obtain the correlation between screening, assessment of nutritional status, and skeletal metastasis in NSCLC patients and to obtain the prevalence and risk factors involved in it from the results.

3. RESULTS AND DISCUSSION

A total of 100 individuals with non-small cell lung cancer diagnoses were included in the current investigation. Table 1 illustrate that, for the January 2023–January 2024 period, the age distribution of patients reveals a higher proportion of male subjects than female subjects. There were no male patients in the age range of 26 to 35 among the 82 who were surveyed. Ages 66 to 75 made up the largest group of patients, making up 36.58% of all male patients. Then came people in the 46–55 and 56–65 age groups. Groups 86 years of age or more and 76-85 years of age, which comprised 6.09% of patients who were male, were the two smallest age groups. The 18 female patients ranged in age from 56 to 65 for the most part. The age groups 36–45 and 46–55 was the next largest. The absence of female patients aged 86 and above was noteworthy. Compared to men, the age distribution of females is younger. In general, NSCLC incidence was higher in older male patients—especially those between the ages of 66 and 75—than in female patients, who are generally classified as being between the ages of 56 and 65. The age-specific prevalence of NSCLC in the study group is demonstrated by these results.

Table 1: Consolidated table of age-wise distribution for NSCLC

AGE	MALE (n=82)	FEMALE (n=18)	TOTAL
26-35	0	5.55%	1%
36-45	9.7%	16.6%)	11%
46-55	15.8%	22.2%	17%
56-65	28%	33.3%	29%
66-75	36.5%	16.6%	33%
76-85	6%	5.5%	6%
86 or above	3.6%	0	3%

***NSCLC-** non-small cell lung cancer

Table 2 show the gender distribution of non-small cell lung cancer (NSCLC) cases, with 82 of 100 patients being male, accounting for 82% of the total. In contrast, 18 female patients accounted for the remaining 18%. This pattern shows a clear prevalence of NSCLC in male individuals in the study sample. The data in confirms with a significantly higher proportion of male patients than female patients. These data highlight the gender gap in the prevalence of NSCLC, emphasizing the need for gender-specific approaches to prevention, diagnostic, and treatment techniques.

Table 2: Gender-Wise Distribution of Non-Small Cell Lung Cancer

MALE	FEMALE	TOTAL
82%	18%	100

Table 3 shows the stage-specific distribution of non-small cell lung cancer (NSCLC) patients. Of the 82 male cases, none were diagnosed at stage 1. Stage 2 had the highest representation of 26 patient's male and 7 patients female, followed by stages 3 and 4. Overall, the distribution of stages follows a similar pattern across genders, with stages 2 and 3 being the most common among both men and women. This shows that a considerable proportion of NSCLC patients are detected in advanced stages (3 and 4), emphasizing the difficulty of early identification and the crucial need for better screening and diagnostic approaches.

Table 3: Stage-Wise Distribution of Non-Small Cell Lung Cancer Patients

STAGE	MALE (n=82)	FEMALE (n=18)	TOTAL
1	0	0	0
2	31.7%	38.8%	33%
3	37.8%	33.3%	37%
4	30.4%	27.7%	30%

Table 4: Treatment Undergoing distribution of Non-Small Cell Lung Cancer patients

TREATMENT	MALE (n=82)	FEMALE (n=18)	TOTAL
Surgery	3.6%	0	3%
Chemotherapy	85.3%	77.7%	84%
Supportive	9.7%	22.2%	12%
Biopsy	1.2%	0	1%

Table 4 show the distribution of treatments received by non-small cell lung cancer (NSCLC) patients, organized by gender where three of the 82 male patients underwent surgery. The majority of male patients (70 in total) received chemotherapy, followed by supportive care, and the least by biopsy. None of the 18 female patients underwent surgery. Chemotherapy is ranked first, with biopsy receiving no points in females. Overall, chemotherapy was the most common treatment modality for both genders. It depicts the distribution of treatment options among NSCLC patients, emphasizing chemotherapy as the predominant therapeutic method in NSCLC care.

Table 5: Clinical Signs and Symptoms of Non-Small Cell Lung Cancer patients

SYMPTOMS	MALE (n=82)	FEMALE (n=18)	TOTAL
Dysphagia	10.9%	33.3%	15%
Breathlessness	34.1%	50%	37%
Weakness	36.5%	22.2%	34%
Anxiety	71.9%	72.2%	72%
Risk of fall	25.6%	3.3%	27%
Risk for infection	29.2%	4.4%	32%
Fatigue	48.7%	6.6%	52%
Joint pain/stiffness	21.9%	2.2%	22%
Cough	62.1%	72.2%	64%
Exporation	32.9%	27.7%	32%
Chest discomfort	25.6%	61.1%	32%

Table 5 show the distribution of clinical signs and symptoms among non-small cell lung cancer (NSCLC) patients according to gender. Anxiety is the most prevalent symptom among the 82 male patients examined, followed by fatigue, cough, weakness, and breathlessness. Other symptoms, such as the risk of falling, infection, and chest discomfort, were seen to varied degrees. Anxiety was the most common complaint among the 18 female patients, followed by exhaustion, coughing, and shortness of breath. Overall, anxiety and fatigue were the most common symptoms in both genders, affecting 72% and 52% of all NSCLC patients, respectively. Coughing and dyspnea were other common symptoms. Gender differences were apparent in the distribution of specific symptoms, such as dysphagia being more prevalent among females and chest discomfort more frequently reported among females as well.

Table 6: Distribution of substance abuse among Non-Small Cell Lung Cancer patients

HABITS	MALE (n=82)	FEMALE (n=18)	TOTAL
Smoking	54.8%	16.6%	48%
Tobacco	6%	16.6%	8%
Alcohol	29.2%	11.1%	26%
Drugs	0	0	0

Table 6 show the distribution of substance misuse habits among non-small cell lung cancer (NSCLC) patients, broken down by gender. Smoking was the most common substance misuse habit among the 82 male patients, followed by alcohol intake. Tobacco usage was rare, and no male patients reported drug use. Smoking was seen at the highest rate among the 18 female patients, but lower than in men. Overall, smoking was the most common substance misuse habit among NSCLC patients, accounting for 48% of all cases. Alcohol intake and tobacco use were less common, with 26% and 8% of patients, respectively.

Table 7: Risk Factors of Non-Small Cell Lung Cancer

COMORBIDITY	MALE (n=82)	FEMALE (n=18)	TOTAL
Diabetes	43.9%	33.3%	42 %
Hypertension	40.2%	77.7%	47%
CVA	12.1%	27.7%	15%
COPD	28%	27.7%	28%
TB	23.1%	11.1%	21%
Hypothyroidism	4.8%	22.2%	8%
PAH	4.8%	11.1%	6%
IHD	10.9%	0	9%
Osteoporosis	17%	27.7%	19%

Table 7 show the risk factors for non-small cell lung cancer (NSCLC) patients categorized by gender and comorbidity. Diabetes and hypertension were the most common comorbidities among 82 male patients, followed by chronic obstructive pulmonary disease (COPD). Among 18 female patients, hypertension was the most common comorbidity, affecting 77.7%, followed by diabetes.

Table 8: BMI-based classification of Non-Small Cell Lung Cancer

BMI	MALE (n=82)	FEMALE (n=18)	TOTAL
Underweight	37.8%	22.2%	35%
Normal	43.9%	50%	45%
Overweight	10.9%	5.5%	10%
Pre-obese	6%	16.6%	8%
Obese	1.2%	5.5%	2%

Table 8 show the BMI-based classification of non-small cell lung cancer (NSCLC) patients by gender. Overall, the majority of male and female NSCLC patients had normal BMIs (45% and 50%, respectively). Males were more likely to be underweight than females, whereas females were more likely to be pre-obesity or obese. These data point to a diverse distribution of BMI categories among NSCLC patients, which has significance for understanding the link between BMI and lung cancer across genders.

Table 9: Screening score-based classification of Non-Small Cell Lung Cancer patients

SCREENING SCORE	MALE (n=82)	FEMALE (n=18)	TOTAL
Low risk	31.7%	38.8%	33%
Medium risk	34.1%	27.7%	33%
High risk	34.1%	33.3%	34%

Table 9 show the screening score-based classification of NSCLC patients by gender. Overall, each risk category accounted for around one-third of the total patients: low risk (33%), medium risk (33%), and high risk (34%). This distribution shows a rather fair representation across risk levels among male and female NSCLC patients, implying a systematic approach to screening and risk assessment in clinical practice.

Table 10: SGA-based assessment score-wise distribution of Non-Small Cell Lung Cancer

SCORE	MALE	FEMALE	TOTAL
0-7: Malnourished	25.6%	16.6%	24%
8-11: At the risk of malnutrition	43.9%	38.8%	43%
12-14: Normal	30.4%	44.4%	33%

Table 10 show the evaluation score-wise distribution of non-small cell lung cancer (NSCLC) patients grouped by nutritional status, with data separated by gender. Overall, the distribution indicates that 24% of patients were malnourished, 43% were at risk of malnutrition, and 33% were classified as normal for both genders. This study emphasizes the importance of nutritional health in NSCLC patients, with variable levels of risk reported in male and female populations. According to the findings, a considerable number of NSCLC patients may require nutritional interventions or monitoring to improve their health outcomes throughout therapy.

Table 11: Risk of Malnutrition in Non-Small Cell Lung Cancer

MALNUTRITION	MALE	FEMALE	TOTAL
Low risk	31.7%	44.4%	34%
Medium risk	37.8%	27.7%	36%
High risk	30.4%	27.7%	30%

Table 11 show the risk of malnutrition among non-small cell lung cancer (NSCLC) patients, categorized by gender. Overall, the distribution of risk categories shows that 34% of patients were at low risk of malnutrition, 36% were at medium risk, and 30% were at severe risk. These data show a significant gender difference in the risk of malnutrition, with a higher percentage of females classed as low risk than males. This research emphasizes the necessity of nutritional assessment and intervention strategies suited to individual patient needs, especially in the treatment of NSCLC and its consequences.

Table 12: Metastasis-wise distribution of Non-Small Cell Lung Cancer

METASTASIS	MALE	FEMALE	TOTAL
Left lung	28%	27.7%	28%
Right lung	46.3%	27.7%	43%
Adrenal	12.1%	0	10%
Bone	31.7%	22.2%	30%
Prostrate	12.1%	16.6%	13%
Renal	13.4%	22.2%	15%
Liver	17%	22.2%	18%
Brain	18.2%	16.6%	18%

Table 12 show the distribution of metastases among NSCLC patients according to gender. Male patients' most prevalent metastatic locations were the right lung, followed by the bone, liver, and brain. Females had fewer or no metastases to the adrenal gland, prostate (not applicable), and kidney. Overall, the distribution of metastatic locations shows that prevalence varies by gender, with similarities in some (such as bone and brain) and variances in others (such as prostate and renal).

Table 13 : Stage-wise screening score in Non-Small Cell Lung Cancer

STAGE	LOW RISK	MEDIUM RISK	HIGH RISK
1	0	0	0
2 (n=33)	17	16	0
3 (n=37)	11	15	11
4 (n=30)	5	2	23

Table 13 shows the stage-wise distribution of screening scores among non-small cell lung cancer (NSCLC) patients, divided into risk groups. There were no patients with stage one NSCLC. It emphasizes that higher stages (Stages 3 and 4) are associated with a higher proportion of patients classified as high risk, implying a possible link between disease progression and the risk of complications or poor outcomes caused by malnutrition or other factors assessed by screening scores.

Table 14: Stage-wise assessment score in Non-Small Cell Lung Cancer

STAGE	MALNOURISHED	AT THE RISK OF MALNUTRITION	NORMAL
1	0	0	0
2 (n= 33)	0	13	20
3 (n= 37)	7	20	10
4 (n= 30)	17	10	3

Table 14 show the stage-wise distribution of assessment scores among non-small cell lung cancer (NSCLC) patients at various stages of the disease. There were no patients recorded in stage one. It shows that as the disease advances to more advanced stages (Stages 3 and 4), the proportion of patients classified as malnourished or at risk of malnutrition increases, emphasizing the importance of disease severity on nutritional status. These findings highlight the necessity of nutritional assessment and management options targeted to the unique needs of NSCLC patients at various stages of the disease.

4. DISCUSSION

Frega S, Ferro A et.al have reported men have a slightly higher lifetime risk of being diagnosed with cancer (40.1%) than women (38.7%). Overall, a man's likelihood of developing LC in his lifetime is roughly 1 in 15, whereas a woman's risk is about 1 in 17. [19] The age-wise distribution of the patients where male subjects is higher than that of females and in the age group 66-75 years. Females have a younger age distribution than males. Goyal G et.al has reported that patients treated for stage IV NSCLC at high-volume hospitals had a decreased risk of all-cause death than those treated at low-volume facilities, which may become more relevant in the future era of customized treatment of stage IV NSCLC.[20] Table 4.3 and Figure 4.3 show the stage-specific distribution of non-small cell lung cancer (NSCLC) patients. This shows that a considerable proportion of NSCLC patients are detected in advanced stages (3 and 4), emphasizing the difficulty of early identification and the crucial need for better screening and diagnostic approaches. Ahn BC, Pyo KH et.al have reported that the National Clinical Cancer Network and American Society of Clinical Oncology guidelines recommend no more than two lines of cytotoxic chemotherapy for advanced NSCLC. Instead, immunotherapy, supportive care, or clinical trials are recommended.[21] The distribution of treatments received by non-small cell lung cancer (NSCLC) patients, organized by gender. Chemotherapy is ranked first in both males and females. It depicts the distribution of treatment options among NSCLC patients, emphasizing chemotherapy as the predominant therapeutic method in NSCLC care. Xing PY, Zhu YX et.al have reported that according to their analysis, the most common symptoms and physical signs of lung cancer were chronic coughs, chest pain, shortness of breath, and weight loss.[22] The distribution of clinical signs and symptoms among non-small cell lung cancer (NSCLC) patients according to gender. Anxiety is the most prevalent symptom among both female and male patients examined, followed by fatigue, cough, weakness, and breathlessness. Cedzyńska M et.al has reported that failure to advise the patient about the need to quit smoking for the efficacy of his anticancer treatment and overall survival should be deemed malpractice.[23] The distribution of substance misuse habits among non-small cell lung cancer (NSCLC) patients. Smoking was the most common substance misuse habit among both male and female patients, followed by alcohol intake. Rios J, Gosain R et.al have reported that the most common comorbidities in lung cancer patients are chronic obstructive pulmonary disease, coronary artery disease, congestive heart failure, diabetes, and renal insufficiency.[24] The risk factors for non-small cell lung cancer (NSCLC) patients categorized by gender and comorbidity. Diabetes and hypertension were the

most common comorbidities among both male and female patients, followed by chronic obstructive pulmonary disease (COPD). The BMI-based classification of non-small cell lung cancer (NSCLC) patients by gender. Overall, the majority of male and female NSCLC patients had normal BMIs (45% and 50%, respectively). The stage-wise distribution of screening and assessment scores. It emphasizes that higher stages (Stages 3 and 4) are associated with a higher proportion of patients classified as high risk, implying a possible link between disease progression and the risk of complications or poor outcomes caused by malnutrition or other factors assessed by screening scores. The metastases among NSCLC patients according to gender. Male patients' most prevalent metastatic locations were the right lung, followed by the bone, liver, and brain. Females had fewer or no metastases to the adrenal gland, prostate (not applicable), and kidney. Overall, the distribution of metastatic locations shows that prevalence varies by gender, with similarities in some (such as bone and brain) and variances in others (such as prostate and renal).

5. CONCLUSION

The study has shown that smoking behaviours are a significant factor in the development of the disease since men are more likely than women to be habituated to smoking, which affects the prevalence rate in both genders. The most common type of treatment that has been found was chemotherapy. The majority of patients have anxiety, weakness, exhaustion, and increased coughing, which may be brought on by changing illness conditions or ongoing treatments. Also, BMI alone cannot be used for the malnutrition analysis or nutritional status, screening and assessment test are must in assessing the nutritional status of the patients, also progression in disease stage reduces the nutritional status. Reduced nutritional status raises the risk of skeletal metastasis because it causes the body to lose vital nutrients, which lowers body weight and accelerates the progression of the disease, all of which have an adverse effect on quality of life. Further study is also required on screening, assessment instruments, and nutritional status progression in order to slow the course of the disease and improve the quality of life for the patients.

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