Original Article

Alterations in body composition in Indian patients with non-small cell lung cancer

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ABSTRACT

Background: Alterations in body composition are common in cancer and may affect outcomes differentially based on geographical and ethnic factors. However, data in lung cancer are sparse and conflicting. **Methods:** We compared the body composition of Indian lung cancer patients with healthy subjects using a retrospective review of all newly diagnosed patients with nonsmall cell lung cancer. Age- and sex-matched healthy controls were recruited prospectively. Basal metabolic rate (BMR), total body water (TBW), fat mass, and fat-free mass (FFM) were calculated by bioelectric impedance method. **Results:** A total of 256 patients (83.6% males) and 210 controls (81.4% males) were studied. The mean (standard deviation) age of patients was 54.5 (9.0) years, median smoking index was 598.2 (range, 0–2500), and median Karnofsky performance scale (KPS) was 80 (range, 40–100). Majority (54.7%) had Stage IV disease. All components of body composition, i.e., BMR, TBW, fat mass, and FFM, were significantly lower ($P < 0.01$) in patients as compared to controls. Body mass index, fat mass, FFM, and TBW were lower in older subjects with poorer KPS. The presence of metastasis or symptom duration did not affect body composition. **Conclusion:** These results indicate that Indian patients with lung cancer have altered body composition which declines with increasing age and worsening performance status.

KEY WORDS: Body composition, lung cancer, performance status

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INTRODUCTION

Malignancies, including lung cancer, are associated with significant alterations in nutritional status, which in turn, has important implications on quality of life and prognosis.[1,2] In recent years, body composition had been demonstrated to be an important indicator of malnutrition in cancer patients and a predictor of survival and length of hospitalization.[3,4]

Body composition is measured using the technique of bioelectric impedance analysis (BIA), which is based on the electrical properties of body tissues. At a frequency of 50 kHz, small currents, for example 500 μA, are able to pass through both intra- and extra-cellular fluid in varying proportions in different types of tissues. Single frequency BIA at 50 kHz can estimate individual components of body composition such as body fat percentage, fat mass, fat-free mass (FFM), and total body water (TBW) using predictive equations. However, data regarding BIA of body composition in lung cancer are sparse. Previous studies have shown conflicting results, had small sample sizes, or were performed in groups that included other cancers apart from the lung. Baracos *et al.*[5] demonstrated that 61% of males and 31% of females with Non-small cell

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/lungindia.lungindia_369_17

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How to cite this article: Mohan A, Poulose R, Ansari A, Madan K, Hadda V, Khilnani GC, *et al.* Alterations in body composition in Indian patients with non-small cell lung cancer. Lung India 2019;36:295-8.

lung cancer (NSCLC) had underlying sarcopenia, even when only a quarter of patients had symptoms of weight loss. Maturo *et al*.[6] reported significant reduction of lean body mass in prostate cancer, while Fouladiun *et al*.[3] demonstrated a greater loss of body fat compared to lean body mass. However, body composition of Indian patients may differ from other populations based on ethnicity, dietary patterns, or geographical location. We hypothesized that the disease process in Indian subjects with lung cancer leads to alteration in body composition. The aim of our study was, therefore, to compare the body composition of lung cancer patients with that of healthy subjects.

METHODS

A retrospective chart review was conducted on all newly diagnosed patients with NSCLC visiting All India Institute of Medical Sciences, New Delhi, over 3 years from 2012 to 2015. Patient demographics, clinical history, and smoking history were obtained. Subjects were grouped as current smokers, former smokers (those who had quit smoking for at least the last 6 months), or nonsmokers (lifetime smoking index <100). Performance status was determined using the Karnofsky performance scale (KPS),[7] which consists of an 11-point scale ranging from 0 (dead) to 100 (asymptomatic with normal activities). Details of the disease stage according to the American Joint Committee on Cancer TNM classification (7th Ed)[8] were recorded based on relevant imaging studies, including computed tomogram (CT) of the chest/abdomen, positron emission tomography-CT scan, bone scan, and CT/magnetic resonance imaging brain as available. Age- and sex-matched healthy controls were recruited prospectively after excluding significant medical conditions based on history and physical examination.

Body composition analysis

Basal metabolic rate, TBW, fat mass, and FFM were calculated by bioelectric impedance method using TANITA TBF 300 body composition analyzer (Tanita Corp., IL, USA). The platform of the analyzer is composed of pressure contact stainless steel footpad electrodes. Herein, after entering the age, sex, and height of the individual into the analyzer, they were asked to stand on the platform barefoot, and a 500 μA alternating current at 50 kHz was passed through the electrodes. A printed report of the above-mentioned parameters was obtained within 10 s.

Statistical analysis

Data were managed on Excel Spreadsheets. Descriptive statistics were used to determine the frequency of symptoms and KPS. Mean and standard deviation (SD) were calculated for continuous variables. Comparison between two groups was done using Student's *t*-test. A $P < 0.05$ was considered statistically significant. All the statistical tests done in this study were two-tailed, and STATA 11.0 version for Windows (STATA Corporation, College Station Road, Houston, Texas, USA) was used for data analysis.

RESULTS

A total of 256 patients (83.6% males) and 210 controls (81.4% males) were studied. The mean (SD) age of the patient group was 54.5 (9.0) years, median smoking index was 598.2 (range, 0–2500), and mean duration of symptoms was 158.3 (91.7) days. The most common symptoms were cough (81.6%), chest pain (67.9%), fatigue (60.6%), shortness of breath (54.3%), loss of weight (51.6%), and loss of appetite (43.8%). The median KPS was 80 (range, 40–100). Majority of the patients had Stage IV disease (54.7%), followed by Stage III (41.4%) and Stage II (3.9%). The proportion of patients with high, normal, and low body mass index (BMI) was 19 (7.4%), 138 (53.9%), and 99 (38.7%), respectively.

Keeping in view the differing body composition between males and females, added to the fact that our sample group comprised of an overwhelming majority of males (83.6%), subgroup comparisons of body composition were made of male and female patients with their respective controls. All components of body composition were significantly lower in both male and female patient groups as compared to their respective control subjects [Table 1].

To assess the impact of age on body composition, we compared body fat%, the major component of body composition, between subjects and controls in blocks of the decade; it was observed that body fat% was significantly lower in patients compared to controls in all decade categories [Figure 1].

KPS values were available for 175 male patients. Taking into account the median KPS value, individuals were divided into two groups and the body composition was compared between them. It was observed that BMI, fat mass, FFM, and TBW were significantly lower in individuals with lower KPS [Table 2]. No significant difference was found in the body composition between patients with/without metastatic disease.

Table 1: Gender specific comparison of body composition between patients and controls

Variable	Male patients (*n*=214)	Male controls (*n*=171)	*P*
Age (years)	54.5 (8.9)	53.3 (9.2)	0.11
BMI (kg/m^2)	20.0 (3.5)	24.5 (3.8)	<0.01
Body fat %	16.4 (8.3)	21.6 (6.6)	<0.01
Fat mass (kg)	8.8 (5.4)	15.3 (6.6)	<0.01
FFM (kg)	44.3 (7.7)	53.1 (6.2)	<0.01
TBW (kg)	32.4 (5.4)	38.7 (4.9)	<0.01
Variable	**Female patients (*n*=42)**	**Female controls (*n*=39)**	***P***
Age (years)	52.8 (8.9)	51.6 (8.4)	0.5
BMI (kg/m^2)	20.9 (3.9)	26.4 (3.5)	<0.01
Body fat %	23.6 (10.9)	33.9 (6.9)	<0.01
Fat mass (kg)	12.4 (7.8)	22.2 (7.4)	<0.01
FFM (kg)	35.7 (4.7)	41.7 (4.9)	<0.01
TBW (kg)	26.3 (3.3)	30.6 (3.6)	<0.01

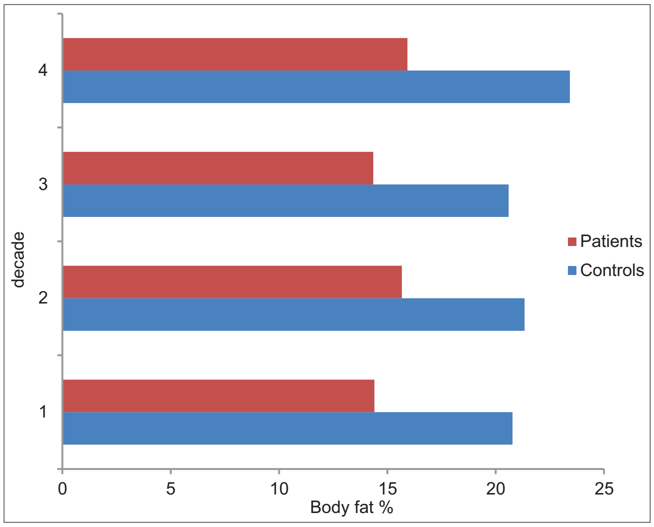

Figure 1: Comparison of Body composition by decade stratification between patients and controls

Table 2: Comparison of body composition between patients based on the KPS

Variable	KPS <80 (*n*=79)	KPS ≥80 (*n*=96)	*P*
Body fat	14.2 (7.1)	16.2 (7.0)	0.07
Fat Mass	7.9 (5.3)	9.7 (5.7)	0.04
Fat Free Mass	44.4 (6.5)	47.3 (6.8)	0.01
Total Body Water	32.5 (4.7)	34.5 (5.1)	0.01
Body Mass Index	19.3 (3.3)	20.8 (3.6)	<0.01

DISCUSSION

Our results indicate that body composition is significantly altered in NSCLC patients. Although majority of our patients had normal weight, their body fat% was significantly lower compared to healthy controls. In addition, body composition differed significantly between patients with better performance status compared to those with worse KPS scores.

The weight loss in lung cancer could be due to a combination of loss of body fat and loss of lean body mass.[9-12] Alterations in lipid metabolism, including increased lipid mobilization and decreased lipogenesis may account for the loss of body fat.[9,11] Sarcopenia is one of the hallmarks of cancer cachexia, and reduced synthesis and increased degradation of protein have been demonstrated in skeletal muscle biopsies of cachectic patients.[5,12]

Previous studies have shown conflicting results regarding body composition in cancer. Maturo *et al.*[6] studied 11 prostate cancer patients and found that lean body mass, but not fat mass, was significantly lower compared to age- and BMI-matched controls. Our results are similar, except that our individuals had significantly lower fat mass and total body water.

Baracos *et al.*[5] analyzed CT images of 441 patients with NSCLC and found that 61% of the men and 31% of the women were sarcopenic, and majority were obese or overweight. Notably, while only a quarter of the patients reported symptoms of significant weight loss, nearly twice that number had underlying sarcopenia. In contrast, majority of our patients had normal weight, but they still had significantly lower FFM compared with controls. This might suggest that a normal weight in a lung cancer patient might not be so normal after all but may actually be concealing underlying sarcopenia. Loss of skeletal muscle has been associated with increased incidence of nosocomial infections, functional impairment, and physical disability.[13,14]

The sparse literature on body composition in malignancies has yielded conflicting results. Among 311 patients with solid gastrointestinal tumors, Fouladiun *et al.*[3] demonstrated a disproportionally higher loss of body fat compared to lean body mass loss in patients with progressive disease. However, Moley *et al.*[15] found that fat and body cell mass reduced in equal proportion in 104 patients with upper gastrointestinal malignancies. Similar results were demonstrated in a small longitudinal study in nine cancer patients.[16]

In contrast, our patients were newly diagnosed and treatment naive and thus might have differed from the subjects of the above study both in terms of disease type and severity. This might account for the conflicting results which were obtained when patients were compared with age- and BMI-matched controls.

The effect of age on body composition was demonstrated by Bemben *et al.*,[17] who showed that increased age is associated with declining FFM and increased body fat. It is also reported that females tend to have greater adiposity compared to males. Hence, we compared patients with age- and sex-matched controls in an attempt to negate the effects of these factors on body composition. Second, we compared fat% in different age strata decade-wise and observed that the patients had a significantly lower body fat compared to controls across all age groups. However, one must take into account the fact that not only different methods were used to estimate body composition in the above-mentioned studies, but also considerable heterogeneity existed in the disease types, severity, and sample size. These factors probably explain the variability in results obtained in most previous studies.

Our results demonstrate a significant difference in body composition between those with the higher KPS scores when compared to those with comparatively lower KPS scores. This is an important finding because performance status parameters, including KPS, are strongly associated with other outcome measures, such as quality of life and survival.[18,19] We could not find any prior reference evaluating the association between performance status and body composition in lung cancer. Our results indicate the possibility that body composition may be indirectly associated with clinically meaningful outcome parameters, although this has not been specifically evaluated in the current study.

The relationship between body composition and outcome parameters has, however, been evaluated previously. Fouladiun *et al*.[3] demonstrated that body fat was one of the predictors of survival in solid tumors, mostly gastrointestinal in origin, while lean body mass lacked any predictive value. Lower FFM has been proposed as an independent risk factor for malnutrition and longer hospital stay.[4] The impact of lower body fat on the volume of distribution of antineoplastic drugs was demonstrated by Prado *et al*.,[20] who showed that lean body mass was a significant predictor of cytotoxicity in 5-fluorouracil chemotherapy.[20]

The obvious limitations of our study include its retrospective design and the lack of dietary history. This study was cross-sectional; hence, the patients were not followed up to track further changes in body composition. However, considering our large sample size of patients and an age- and sex-matched control group, we had a good statistical power to evaluate change in body composition in predominantly advanced lung cancer patients. To the best of our knowledge, this is the first study to look at body composition parameters in a large group comprising solely lung cancer patients using the novel bioimpedance technique. This information may be useful in designing appropriate nutritional therapy to attempt improve clinical outcomes. Additional studies, however, are required to evaluate the temporal sequence of change in body composition in lung cancer and its utility as a prognostic or monitoring parameter.

CONCLUSION

Indian patients with advanced NSCLC have markedly altered body composition, which is significantly associated with increasing age and worsening performance status. Although the prognostic utility of these parameters needs further exploration, the results may emphasize the need to incorporate nutritional therapy into lung cancer management programs.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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