

# Report on Exploring the Relationship Between Gender and Weight Loss of Lung Cancer Patients

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**Abstract:** Weight loss, a sign of malnutrition, is known as an important factor in illustrating how well the patients handling their diseases. In general, gender is a key factor in weight loss of patients, as biological differences between males and females result people handle their diseases in different manners. This paper aims to measure if there is a gender difference in weight loss of lung cancer patients, specifically. We collected information from 228 lung cancer patients with both genders in our research. Patients age, moving ability, and weight loss in the last six months were recorded in the dataset. By conducting t-test and drawing graphs of their mobility information, we reached a conclusion suggesting that lung cancer patients experience weight loss, but there appears to be no significant gender difference in weight loss of lung cancer patients in the last six months. In addition, we utilized power calculation to prove that our non-significant t-test result was true. The findings of our research indicated that gender have no or little bearing on lung cancer patients' weight loss, and healthcare institutions may use the findings to design treatment guidance accordingly.

## 1. Introduction

In the health science field, gender is widely acknowledged as a powerful factor in disease, because behavioral and biological differences between males and females result in obvious variations of the seriousness of their disease [1]. Healthcare institutions need to design different treatments based on gender roles, stressors, social relationship, etc. Past researches have shown that for depression, the fluctuation of sex hormones can be an important risk factor. Social factors like sexual violence also influence the severeness of depression [2]. In addition, research on Sex Differences in the Regulation of Cancer-Induced Muscle Wasting showed that females and males have unique characteristics that affect their body function and they need different treatments [3].

However, there were little research specifically investigating gender difference in relation with lung cancer seriousness. In addition, unexplained weight loss is one of the symptoms of severe lung cancer [4]. Therefore, our study will focus on whether the difference in gender is related with different levels of weight loss for lung cancer patients, because weight loss is a sign of malnutrition and it is positively proportionate to the severeness of the disease, we assume that patients who have lost a lot of weight tend to experience worse condition than who've lost less weight [5].

The result of our study would provide treatment guidance for healthcare institutions: If gender difference with weight loss exists, it's likely that males and females recover differently such that healthcare institutions need to plan different treatments for each gender. In the current study, we utilize an online lung cancer dataset and t-test to investigate on if there is difference of true mean between males and females. In addition, we would provide summary statistics corresponding to the main feature of the dataset.

## 2. Method

### 2.1 Sample

The NCCTG Lung Cancer Data provides the survival possibility in patients with advanced lung cancer [6]. Our sample is comprised of 228 people with advanced lung cancer, including 138 males and 90 females in ages from 39 to 82 with the mean and the median of 63. Overall, the range of their age are relatively large. Apart from it, the range of the survival time is wide. The minimum of them is only 5 days while the maximum is up to 2.8 years. The average of the survival time is about 305 days.

Table 1. Basic Information of The Survival Time and Age Collected from The Sample Patients

Basic Information of the Survival Time	Minimum	Maximum	Median	Mean
Survival Time (Days)	5.0	1022.0	255.5	305.2
Age (Years)	39.00	82.00	63.00	62.45

### 2.2 Indexes

We obtained the North Central Cancer Treatment Group (NCCTG) Lung Cancer Data from lixoft website. It contains the rating of how patients perform usual daily activities, which is measured by OG performance scores and Karnofsky performance scores. OG performance score is a rating on how well the patients can walk in daily basis or completely bedbound, rated by the physicians and patients separately. The scale of OG performance score is from 0 to 4 where 0 is asymptomatic, 1 is symptomatic but can still walk, 2 is in bedtime less than 50% of the day, 3 is in bedtimes more than 50% of the day, but not completely bedbound, and 4 is completely bedbound. Karnofsky performance score is a rating on how well the patient can carry out daily activities, measured by physician and patients separately. The score ranges from 0 to 100, where 0 is bad and 100 is good. In addition, this dataset contains patients' weight loss data in the last six months, their age, survival times in days, sex, and calories consumed at meal. This study aims to provide helpful prognostic information based on patients' self-assessment scores along with physicians' assessment scores (2018). This data set was originally presented in Loprinzi et al. (1994). It was a prospective evaluation of prognostic variables collected from questionnaires and survey completed by patients [7].

### 2.3 Data Analysis

We used R to perform a two-sample t-test and a Power calculation, illustrating the results. T-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups. Power calculation is the measurement of the likelihood of type-two error occurrence. Type-two error is the non-rejection of a false null hypothesis. Type-one error is the rejection of true null hypothesis. There are two kinds of hypotheses: the null hypothesis and the alternative hypothesis. The alternative hypothesis assumes that there is a significant difference exists between the true mean and the comparison value, whereas the null hypothesis assumes that there is no significant difference.

## 3. Result

### 3.1 Basic Information About the Samples

Table 2 shows that the minimum weight loss of female patients is -24, which means that the participant gained weight because of the lung cancer, while male patients suffer from the biggest weight loss. Also, we found that although males tend to lose more weight in general, the difference is very small. Considering that there are differences in base weight of two genders, we decide to look at other factors.

### 3.2 The Karnofsky Performance Score Marked by Physicians and Patients

People with lower ECOG performance score, that is, people who are asymptomatic or symptomatic but completely ambulatory still needs much calories to support their daily energy expenditure. Thus, the bedbound degree may have an effect on the weight loss. To minimize the effect of other factors,

we divided the sample by different ECOG score. At the same time, to reduce the influence of the subjective feelings by patients, here we use the data marked by physicians.

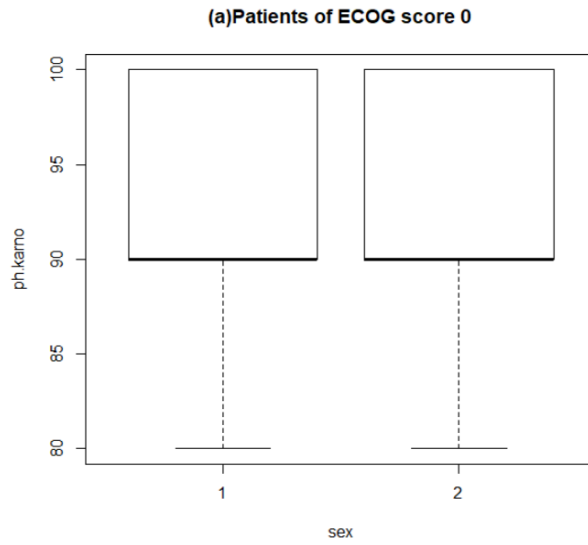


Figure 1. The Karnofsky Scores of Patients of Ecog Score 0.

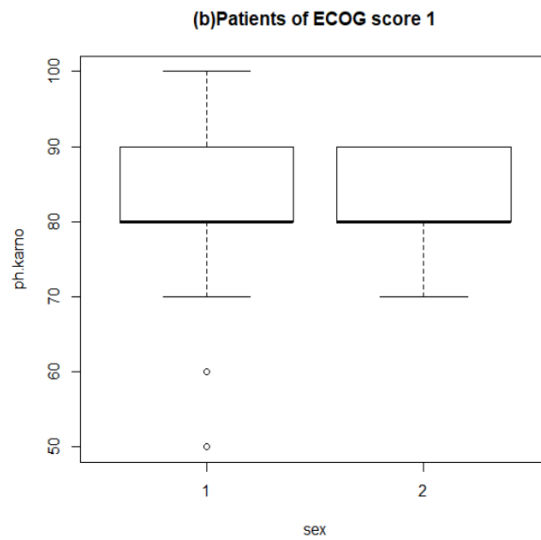


Figure 2. The Karnofsky Scores of Patients of Ecog Score 1

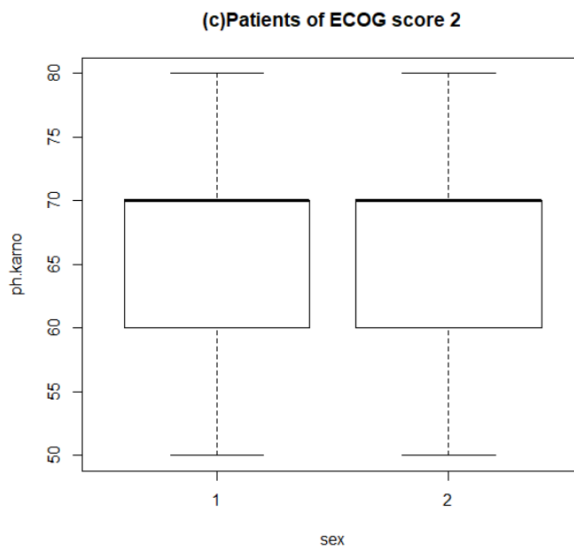


Figure 3. The Karnofsky Scores of Patients of Ecog Score 2.

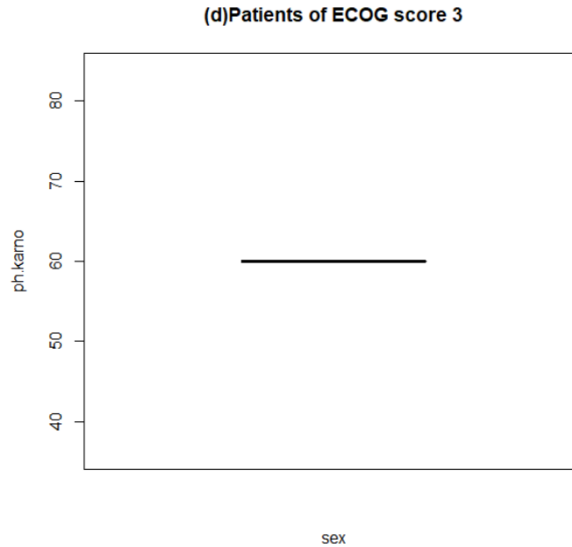


Figure 4. The Karnofsky Scores of Patients of Ecog Score3

Figure 1-4 display the Karnofsky score of the patients of 4 ECOG scores levels based on sex. From the observation of the figures we can speculate that there is little difference between genders in patients' physical condition in the lung cancer. To further test our speculation, we took the t-test to check a particular indicator.

### 3.3 Test the Difference in Weight Loss for Males and Females

First, we calculate the t-value with the formula.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad (1)$$

$$df' = \frac{\left( \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \right)^2}{\frac{\left( \frac{S_1^2}{n_1} \right)^2}{n_1} + \frac{\left( \frac{S_2^2}{n_2} \right)^2}{n_2}} \quad (2)$$

Then with the degree of freedom(df) equals to 180.5, the p-value is 0.06, which is larger than 0.05; therefore, we can't reject the hypothesis. With the p-value we calculated from this dataset, we can make the interpretation that in the sample, there is no true difference in means between males and females when their weight got lost during the lung cancer. Also, the results show that the sample estimates the means of weight loss of female and male are 7.76 and 11.22 respectively.

Since our t-test turns out to be non-significant ( $t = -1.8894$ ,  $p = 0.06 > 0.05$ ), a power calculation is needed to assess if the result is reliable.

### 3.4 Power Calculation

The power of a hypothesis test is the probability that the test rejects the null hypothesis  $\{ \displaystyle H_0 \}$  when alternative hypothesis  $\{ \displaystyle H_1 \}$  is true. In another word, it indicates the probability of avoiding a type II error. The statistical power ranges from 0 to 1. As statistical power increases, the probability of making a type II error occurrence decrease. Statistical power is positively correlated with the sample size, which means that given the level of the other factors, a larger sample size gives greater power.

In research, statistical power is generally calculated for two purposes:

1. When the t-test result is non-significant. Statistical power is calculated to verify whether the non-significant result is accurate or is because of insufficient sample size [8].

2. Decide the sample size needed for a current ongoing study. Power need to be calculated before data collection based on information from previous research [8].

Another concept related with statistical power is effect size. The effect size tells us how relevant the relationship between two variables is in practice. There are two types of effect sizes: effect size based on the proportion of explained variance, and effect size based on the difference in averages. In our case, effect size based on the difference in averages is considered [9].

Effect size based on the difference in averages uses Cohen's *d*. Cohen's *d* suggested that effect size  $d = 0.2$  is considered a small effect size, 0.5 is considered a medium effect size and 0.8 is considered a large effect size. This means that if we see an effect size of 0.8, we know that the two groups' means differ by 0.8 standard deviation; if we see an effect size of 0.5, the two groups' means differ by 0.5 standard deviation; an effect size of 0.2 tells us that the two groups' means differ by 0.2 standard deviation. Generally, consultants recommend that the minimum power level is set to be 0.80 [9].

The calculation shows that when the effect size is 0.2, the power is only 0.3. When we change the effect size to 0.5, the power equals to almost 1. Also, the calculation demonstrates that if there is a 0.2 effect size difference between the true mean of male and female weight, we would not be able to recognize it. If there is a 0.5 difference, we would be able to recognize it.

The result of the power calculation suggests that with the existing sample size, we may not have a significant value in the t-test if we want to detect a 0.2 effect size, but we have enough power to detect a median effect size 0.5. It is recommended that the minimum power level is set to be 0.80. Therefore, our t-test result was true.

#### **4. Discussion**

Our result indicates that there is no gender difference in weight loss of lung cancer patients. By contrast, past researches that investigated on disease of depression and Cancer-Induced Muscle have shown that there is gender difference in relation with the severeness of the disease, and weight plays as an important factor illustrating the seriousness of the disease: more weight loss suggests more severe condition. Our result contradicts with previous findings is partly because the disease we investigate on is distinct from previous research topics such as depression or muscle wasting. We postulate that different diseases would influence body function differently. In addition, the method we utilized is different from research that investigated on depression and muscle wasting: the past researches had bigger sample size and used professional medical diagnostic information in the result analysis, while we collected no information from medical professions. Moreover, we focused on weight loss without considering other factors and concluded that there was no gender difference. In order to fully understand if there is a relationship between genders and severeness of lung cancer, factors other than weight loss, such as hair loss, need to be investigated for obtaining a more rigorous study finding.

The result of our research indicates that gender has no impact on lung cancer severeness since there is no gender difference in weight loss. As such, medical profession may design similar therapeutic methods for both genders.

Nevertheless, there are several limitations of our research. As shown in the power test, a 0.2 effect size between the means of males and females weight loss would be too small to detect. In order to overcome this limitation, an increase in the sample size is necessary. While we could use a higher significant level to increase the power, it is more likely to commit a Type I error. But since a 0.5 effect size between the means of males and females weight loss is detectable, we conclude that the t-test is accurate and there is no need to increase the sample size and the non-significant t-test result was true. In addition, due to the fact that part of the data set is submitted by patients themselves, the validity of the resulted table and diagrams are questionable. Moreover, in this dataset, we have patients with 4 different degrees of bedbound. This means that patients exercise with different amount, and the weight loss is influenced by their exercise amount. We noticed that the sample mainly consists of patients who can still walk or only stay in bed less than 50% of the day while there are only few data about patients who are severely ill, so the conclusion may not be as comprehensive. In order to gain a more precise conclusion, the degree of bedbound need to be set as a controlled variable.

## 5. Conclusion

The power test shows no observable difference between genders in weight losing with the existing sample size.

In addition, the power calculation shows that we would be able to detect a median effect size with the existing sample size. The power calculation proves that the non-significant result from our t-test was true.

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