# Loss of employment duration and productivity for patients with different subtypes and stages of lung cancer

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## Introduction

Several previous investigations have estimated the years of productive life lost and the cost of productivity loss for lung cancer patients; however, these investigations only calculated the loss of productivity related to premature mortality.

In this study, we used workers' wages to quantify the loss of employment duration and loss of lifetime productivity for patients with different pathological subtypes and stages of lung cancer.

## Methods

We interlinked the 2011-2017 Taiwan National Cancer Registry database with the 2011-2018 National Mortality Registry and the 2011-2018 National Health Insurance reimbursement databases for analysis. All lung cancer patients diagnosed at the ages of 50 to 64 years were identified as the index cohort. The reference cohort was the corresponding age-, sex-, and calendar year-matched general population in Taiwan. We compared the life expectancy (LE), lifetime employment duration, and lifetime productivity of the index patients with those of the matched referents to calculate the loss of employment duration and loss of lifetime productivity.

Monthly employed-to-population ratio (EMRATIO) was defined as the ratio of individuals employed at that month to the total number of people in the corresponding age- and sex-specific strata. The EMRATIOs of individuals aged $\geq$ 65 were assumed to be 0 in this study. Because some index patients were not followed up until age 65 or death, we extrapolated the EMRATIO using the following equation:

$$\text{logit}\,(E(t|i)) - \text{logit}\,(E(t|r)) = \beta_0 + \beta_1\,(\log\,(h(t|i)) - \log\,(h(t|r))) + \varepsilon_t$$

where $E(t|i)$ and $E(t|r)$ denote the EMRATIOs at time point $t$ for index patients and corresponding referents, respectively, and $h(t|i)$ and $h(t|r)$ denote the mortality hazards at time point $t$ for index patients and corresponding referents, respectively.

We multiplied the survival functions by the monthly EMRATIOs and working salaries of the index patients and matched referents to estimate their respective employment durations and lifetime productivities.

**Fig. 1 |** Lifetime employment durations (dark shaded areas) and losses of employment duration (light shaded areas).

**Fig. 2 |** Lifetime productivities (dark shaded areas) and losses of lifetime productivity (light shaded areas).
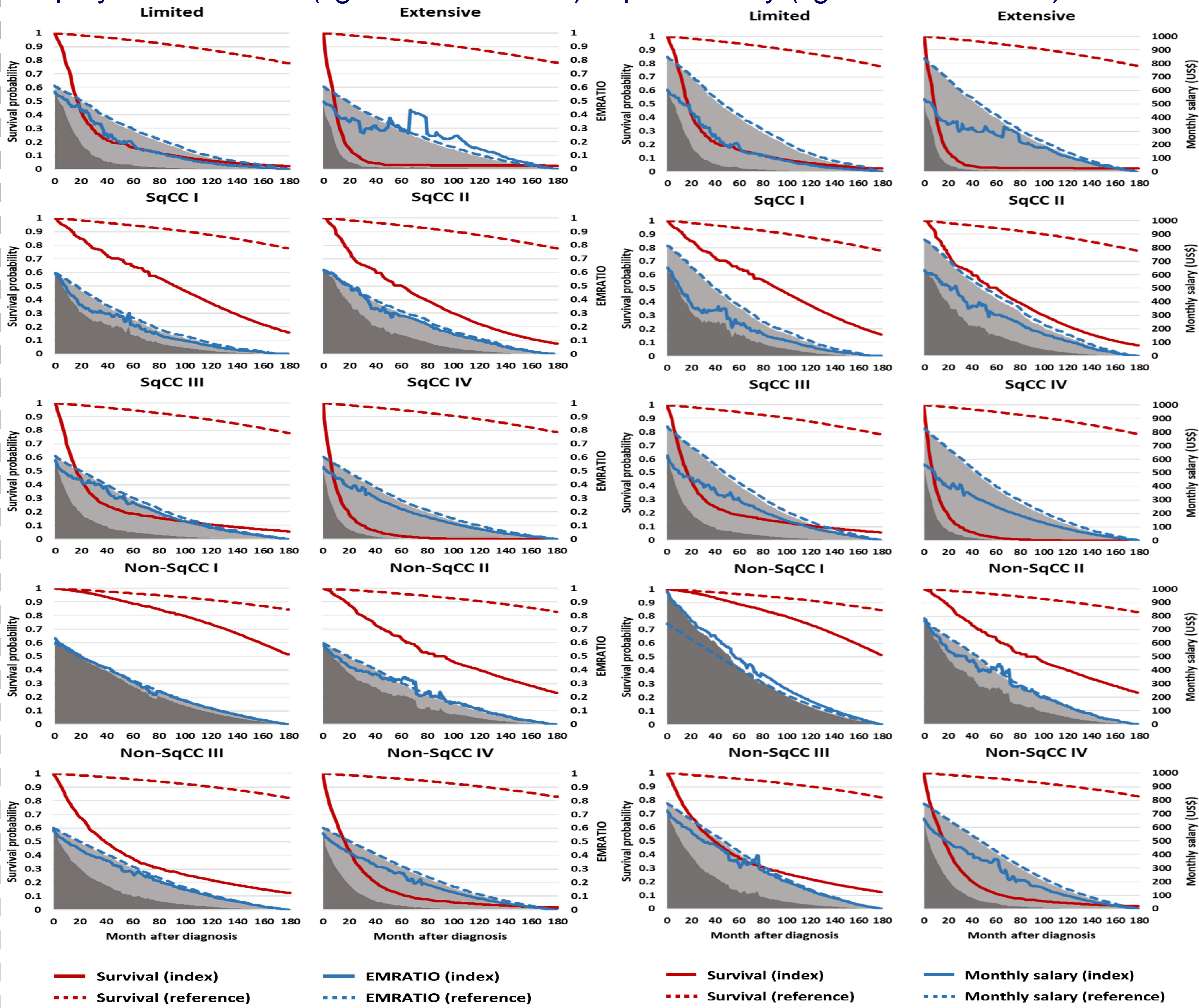


**Table |** Lifetime employment duration and productivity of lung cancer patients, compared with those of age-, sex-, and calendar year-matched referents.

| | Stage | LE *life-year* | Lifetime employment duration *year* | Loss of employment duration *year* | Relative loss of employment duration *mean* | Lifetime productivity *US$* | Loss of lifetime productivity *US$* | Relative loss of lifetime productivity *mean* |
|---|---|---|---|---|---|---|---|---|
| SCLC | Limited | 2.9 | 1.0 | 2.3 | 71% | 11,870 | 43,406 | 79% |
| | Referents | 23.7 | 3.3 | | | 55,276 | | |
| | Extensive | 1.6 | 0.5 | 2.8 | 86% | 5777 | 48,784 | 89% |
| | Referents | 23.8 | 3.2 | | | 54,561 | | |
| SqCC | I | 8.6 | 1.9 | 1.1 | 37% | 24,665 | 24,994 | 50% |
| | Referents | 23.5 | 3.0 | | | 49,660 | | |
| | II | 6.3 | 2.0 | 1.4 | 41% | 25,404 | 32,176 | 56% |
| | Referents | 23.7 | 3.4 | | | 57,580 | | |
| | III | 3.6 | 1.1 | 2.2 | 68% | 13,611 | 41,659 | 75% |
| | Referents | 23.9 | 3.3 | | | 55,271 | | |
| | IV | 1.1 | 0.5 | 2.7 | 86% | 5964 | 47,480 | 89% |
| | Referents | 24.0 | 3.2 | | | 53,444 | | |
| Non-SqCC | I | 15.3 | 3.3 | 0.3 | 7% | 60,683 | -7429 | -14% |
| | Referents | 26.5 | 3.5 | | | 53,254 | | |
| | II | 9.6 | 2.4 | 1.0 | 30% | 35,716 | 16,511 | 32% |
| | Referents | 25.7 | 3.4 | | | 52,227 | | |
| | III | 6.2 | 1.7 | 1.8 | 52% | 25,514 | 28,595 | 53% |
| | Referents | 25.5 | 3.4 | | | 54,109 | | |
| | IV | 2.5 | 0.9 | 2.6 | 74% | 12,690 | 42,006 | 77% |
| | Referents | 25.8 | 3.5 | | | 54,696 | | |

## Conclusion

This methodology could be applied for estimating the productivity loss of cancer survivors or patients with other chronic illnesses.