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Editorial

Influencing Factors of Forced Expiratory Volume for Lung Cancer Patients

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EDITORIAL

Surgery plays a principal role in the exact management, diagnosis and staging of non-small cell lung cancer. Lung resection offers the most probable of cure for localized primary lung cancer patients, which is highly associated with mortality, a risk of decreased postoperative lung function, and other complications [1,2]. One of the most fundamental criteria of fitness for lung resection surgery is a preoperative forced expiratory volume in 1 second (FEV1) >2.0 litre (for pneumonectomy), or >1.5 litre (for lobectomy), which shows the suitability for surgery. However, lower FVE1 values invite further diagnosis of respiratory function. Thus, the principal hypothesis in the report is: what are the variables/factors that decrease or increase the FEV1 values? Note that the response FEV1 is a continuous, positive and non-constant variance random variable. The determinants of FEV1 can only be derived with suitable probabilistic modeling. As FEV1 is a positive and heteroscedatic, it should be modeled by joint generalized linear models (JGLMs) with Gamma or Log-normal distribution, which is clearly explained in [3-5]. The report examines the above hypothesis with a real data set using JGLMs.

The considered data set was obtained from 470 primary lung cancer patients having major lung resections during the years 2007 to 2011 at Wroclaw Thoracic Surgery Centre. The data set is displayed in UCI Machine Learning Repository. The data collection method, and along with 17 covariates description is given in [6]. For necessary use of the covariates, they are restated as follow.

- Diagnosis (DGN)-specific combination of ICD-10 codes for primary (=1), secondary (=2), and multiple tumours (=3) if any (DGN3, DGN2, DGN4, DGN6, DGN5, DGN8, DGN1),
- Volume that has an exhaled at the end of the first second of forced expiration (FEV1),
- Forced vital capacity (FVC),
- Performance status in Zubrod scale (PRZ) (PRZ2=3, PRZ1=2, PRZ0=1),
- Haemoptysis before surgery (HBS) (True (T)=2, False (F)=1),
- Pain before surgery (PBS) (True (T)= 2, False (F) =1),
- Dyspnoea before surgery (DBS) (T=2, F=1),
- Weakness before surgery (T=2, F=1),

- Cough before surgery (T=2, F=1),
- Size of the original tumour (OC11=1 (smallest), OC12=2, OC13=3, OC=14=4 (largest)),
- Myocardial infraction up to 6 months (T=2, F=1),
- Diabetes mellitus (Type 2) (T=2, F=1),
- Peripheral arterial disease (T=2, F=1),
- Smoking status (T=2, F=1),
- Age at surgery,
- Asthma (T=2, F=1),
- One year survival period after surgery (T=2, F=1).

For the above data set, the determinants of FEV1 are identified in the report using JGLMs. Here FEV1 has been considered as the response and the remaining others are considered as the explanatory variables of it. It has been modeled using both the distributions Log-normal and Gamma distributions [3-5]. Final model has been accepted based on model diagnostic check and the lowest value of Akaike information criterion value [7]. Some related studies are given in [8,9]. Based on the approximately true derived model of FEV1, the following influential factors of FEV1 can be noted.

- FEV1 is positively associated with force vital capacity (FVC) (P<0.0001), indicating that FEV1 is higher if FVC is higher. Note that FEV1 is the air quantity that an individual can forcefully exhale in 1s of the FVC test.
- FEV1 is negatively partially associated with age (P=0.1348), concluding that FEV1 is higher at younger ages, which is observed in practice.
- FEV1 is negatively related with performance status (PRZ) (PRZ2=3, PRZ1=2, PRZ0=1) at level (PRZ1) (P=0.0092) & level (PRZ2) (P=0.0196), implying that lung cancer patients at level PRZ0 have higher FEV1 than at levels PRZ1 & PRZ2.
- FEV1 is positively partially associated with pain before surgery (PBS) (True (T)= 2, False (F) =1) (P=0.1392), interpreting that FEV1 is higher for lung cancer patients having PBS than without PBS.
- FEV1 is positively partially associated with dyspnoea before surgery (DBS) (T=2, F=1) (P=0.1505), indicating that FEV1 is higher for lung cancer patients having DBS than without DBS.
- FEV1 variance is negatively associated with FVC (P<0.0001), implying that it increases as the FVC decreases.
- FEV1 variance is negatively associated with age (P<0.0001), concluding that it is higher at younger age than older.
- FEV1 variance is negatively associated with performance status (PRZ) (PRZ2=3, PRZ1=2, PRZ0=1) at level level (PRZ2) (P<0.0001) and (PRZ1) (P<0.0001), interpreting that it is higher at level PRZ0 than for lung cancer patients at levels PRZ1 & PRZ2.
- FEV1 variance is positively associated with haemoptysis before surgery (HBS) (T=2, F=1) (P<0.0001), implying that it is higher for lung cancer patients with HBS than without.
- FEV1 variance is positively associated with dyspnoea before surgery (DBS) (T=2, F=1) (P<0.0001), implying that it is higher for lung cancer patients with DBS than without.
- FEV1 variance is positively partially associated with smoking habit (T=2, F=1) (P=0.0837), concluding that it is higher for smoker lung cancer patients than non-smokers.

Table 1: Mean and variance associations of FEV1 with other factors

Response	Associate with	Types of Association	P-values
Mean FEV1	FVC	Positive	<0.0001
	Age	Negative	0.1348
	Performance status PRZ=1	Negative	0.0092
	Performance status PRZ=2	Negative	0.0196
	Pain before surgery	Positive	0.1392
	Dyspnoea before surgery	Positive	0.1505
Variance FEV1	FVC	Negative	<0.0001
	Age	Negative	<0.0001
	Performance status PRZ=1	Negative	<0.0001
	Performance status PRZ=2	Negative	<0.0001
	Haemoptysis before surgery	Positive	<0.0001
	Dyspnoea before surgery	Positive	<0.0001
	Smoking habit	Positive	0.0837

Note that in Epidemiology, partially significant effects are known as confounders. Here the confounders around 15% level of significance are included in the model. The above associations of FEV1 are summarized in (Table 1). It is found herein that younger lung cancer patients with performance status PRZ=0 have higher FEV1. Older lung cancer patients

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without pain or dyspnoea before surgery should be diagnosed very carefully.

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REFERENCES

1. Lackey A, Donington JS. (2013). Surgical Management of Lung Cancer. Semin Intervent Radiol. 30: 133–140.
2. Rocco G, Internullo E, Cassivi SD, Van Raemdonck D, Ferguson MK. (2008). The variability of practice in minimally invasive thoracic surgery for pulmonary resections. Thorac Surg Clin. 18: 235–247.
3. Lee Y, Nelder JA, Pawitan Y. (2017). Generalized Linear Models with Random Effects (Unified Analysis via H–likelihood). Second Edition, London: Chapman & Hall 2017.
4. Das RN, Lee Y. (2009). Log-normal versus gamma models for analyzing data from quality-improvement experiments. Quality Engineering. 21: 79-87.
5. Qu Y, Tan M, Rybicki L. (2000). A unified approach to estimating association measures via a joint generalized linear model for paired binary data. Communications in Statistics – Theory and Methods. 29: 143–156.
6. Zieba M, Tomczak JM, Lubicz M, Swiatek J. (2014). Boosted SVM for extracting rules from imbalanced data in application to prediction of the post-operative life expectancy in the lung cancer patients. Applied Soft Computing. 14: 99–108.
7. Hastie T, Tibshirani R, Friedman J. (2009). The Elements of Statistical Learning, Second Edition, Springer-Verlag.
8. Das RN. (2017). Forced expiratory volume factors of stage III non-small cell lung cancer patients. Arch Gen Intern Med. 1: 3-7.
9. Das RN, Mukherjee S. (2017). Joint Mean-variance overall survival time fitted models from stage III non-small cell lung cancer. Epidemiology (Sunnyvale). 7: 296.