Lead time bias correction in breast cancer screening studies

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Résumé

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Introduction

Mammography screening plays a crucial role in detecting and diagnosing breast cancer, enabling early treatments and thereby improving survival rates. Evaluating the effectiveness of screening involves comparing the survival of patients diagnosed through screening with those diagnosed after the onset of symptoms. However, this analysis is susceptible to biases that may overestimate the benefits of screening. The lead-time bias arises because screening allows for the early diagnosis of breast cancer, resulting in a longer observed survival without a true improvement in the date of death. The objective is to apply the two lead time correction methods on real data in order to compare them.

Methods

The first approach is based on the sojourn time in the preclinical phase, i.e., the period during which the tumor is detectable through screening without causing symptoms. A distribution of this duration can be derived from a multi-state model. The correction proposed by Duffy et al. (2008) subtracts the expected value of this distribution from the observed survival. The second approach, developed by Abrahamsson et al. (2020), uses a tumor growth model to estimate the hypothetical time from the cancer diagnosed by screening until a symptomatic diagnosis. This model involves estimates of screening sensitivity and tumor growth before the breast cancer diagnosis.

Results

The two approaches give different lead time estimates. The probability of survival at 5 years

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for screen-detected patients is 0.95 without correction, 0.87 using the multi-state approach, and 0.93 with the tumor growth approach. The post-diagnosis survival after correction remains better in screen-detected cases than in symptomatic cases, which is 0.85 at five years.

Conclusion

The tumor growth approach seems more precise in estimating lead time but remains underutilized due to its novelty, complexity and lack of available software. Standardizing its use would be relevant, especially considering criticisms of the Duffy correction, deemed excessive.

Keywords: Breast cancer, screening, lead time, survival, bias correction.

References

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