Kaplan-Meier Survival Analysis Explanation

The censored observations of the primary outcome are best referred to as right censored (answer c).

The trial investigated if a low dose of ramipril (1.25 mg/day), when compared with placebo, reduced the incidence of cardiovascular and renal events in patients with type 2 diabetes who had microalbuminuria or proteinuria. Participants received their usual treatment in addition to their allocated intervention. The length of time following randomisation until occurrence of the primary outcome—a cardiovascular or renal event—is referred to as “time to event data” or “survival data.” Survival data comprise the time it takes a patient to reach an end point. The term “survival data” is perhaps misleading because the end point does not have to be death or an adverse event. The end point might be positive—such as recovery from an operation.

The researchers reported that, of 2443 participants randomised to ramipril, 362 (14.8%) experienced a cardiovascular or renal event, compared with 377 (15.3%) of 2469 participants randomised to placebo. If a participant experienced a cardiovascular or renal event during follow-up, their survival time was known and is referred to as “exact.”

The distinguishing feature of survival data is that typically some participants do not experience the end point before the end of follow-up. In the trial above, most of the participants were followed until the end of the study without experiencing a cardiovascular or renal event. Furthermore, some participants either withdrew and refused to be followed up subsequently or were lost to follow-up. Exactly when any of these participants experienced a cardiovascular or renal event, if at all, is not known. For all of these participants, their survival time was recorded as the time after randomisation until when last observed during follow-up; all that is known is that the time after randomisation until when they experienced the primary outcome (if at all) exceeded their length of follow-up. For that reason their survival times are called “right censored” (answer c), often referred to as “censored.” Right censoring is the most common in medical research. Two other types are sometimes observed—that is, left censoring and interval censoring described below.
All survival data, including exact and censored times, were used in order to compare treatment groups in the trial above. Kaplan-Meier survival analysis was used to construct the curves that display the survival experiences of the two treatment groups (figure). Interpretation of Kaplan-Meier survival curves has been described in previous questions.

Kaplan-Meier survival curves for the treatment groups of ramipril (1.25 mg/day) and placebo of the time until a cardiovascular or renal event.

Left censoring (answer a) occurs if the survival time for a research participant is known to be less than a particular length of time. The participant experienced the study end point, but it is not known when, only that it was after recruitment to the study but before a clinical investigation or consultation. Interval censoring (answer b) occurs if the research participant experiences the study end point within a particular interval—for example, between two clinical investigations or consultations. Left censoring and interval censoring typically occur when participants are not monitored continuously, but perhaps only at
certain times during follow-up. Left censoring is a special case of interval censoring, as the end point will have occurred in the interval after entry to the study and before the investigation when it was established the end point had already occurred.

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