

Serum sodium rate of change and variability: associations with survival in incident hemodialysis patients in the MONDO data base

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Introduction and Aims

Low pre-hemodialysis (HD) serum sodium (SNa⁺) has been associated with higher mortality in HD patients (Waikar, *Am J Med.* 2011). Increased pre-HD SNa⁺ variability has been linked to mortality, while stable SNa⁺ levels have been associated with better survival mortality (Raimann, ERA-EDTA 2012). Here we investigated the joint relationship of SNa⁺ variability (expressed as standard deviation, SD) and rate of change of SNa⁺ (slope of SNa⁺) with the risk of all-cause death in incident HD patients.

Methods

We studied 20,193 incident HD patients from Europe (N=14,763) and the U.S. (N=5,430). During baseline (first 12 months on HD) mean SNa⁺, SNa⁺ slope and SNa⁺ SD were computed. Patient outcomes were noted in follow-up (months 13 to 24). We investigated the joint effects of SNa⁺ and (a) SNa⁺ variability and (b) SNa⁺ slopes, respectively, during baseline on probability of death during follow-up using logistic regression with smoothing spline ANOVA models. Models were adjusted for age, gender, diabetes, IDWG%, serum albumin, phosphorus and BMI

Results

Risk of death was lowest with SNa⁺ around 138 to 141 mEq/L and SNa⁺ SD of 0 to 2 mEq/L. Deviations from this region in any direction were associated with increased risk. The increase in mortality risk associated with higher SNa⁺ variability was steepest at SNa⁺ levels <135 mEq/L (Fig 1). Stable SNa⁺ conferred the lowest risk with SNa⁺ levels around 139 to 142 mEq/L (Fig 2). Mortality risk progressively increased outside of this domain. Of note, over the range of our data, SNa⁺ departures from this range carried a steeper risk increase than departures in SNa⁺ slope. Lastly, while patients with SNa⁺ >136 mEq/L had their best survival probability with SNa⁺ slopes around zero, in patients with SNa⁺ <136 mEq/L more positive SNa⁺ slopes were always linked to better survival along the entire range of SNa⁺ slopes (Fig 2).

Conclusion

This joint analysis of SNa⁺, SNa⁺ slope and SNa⁺ variability suggests effects of SNa⁺ variability and rate of change at all levels of SNa⁺ on mortality. Stable SNa⁺ appears to confer a survival benefit, whereas low SNa⁺ levels associate with an increased risk of all-cause death. Further research into these dynamic aspects of SNa⁺ levels may help to identify patients at increased risk

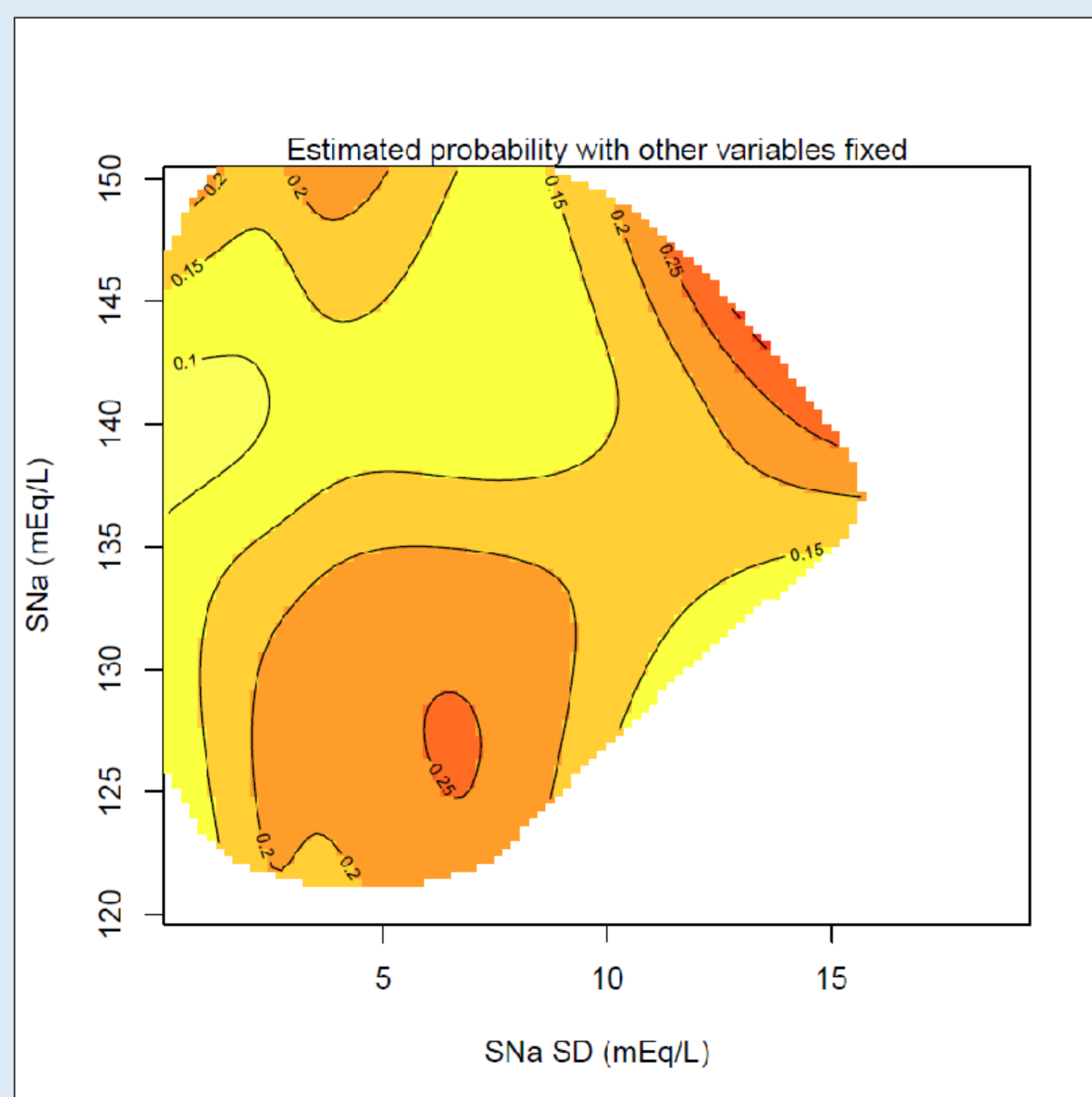


Figure 1: Contour plot of the estimated probability of death as a function of SNa⁺ and SNa⁺ SD for male, diabetic patients with other continuous variables fixed at their median values)

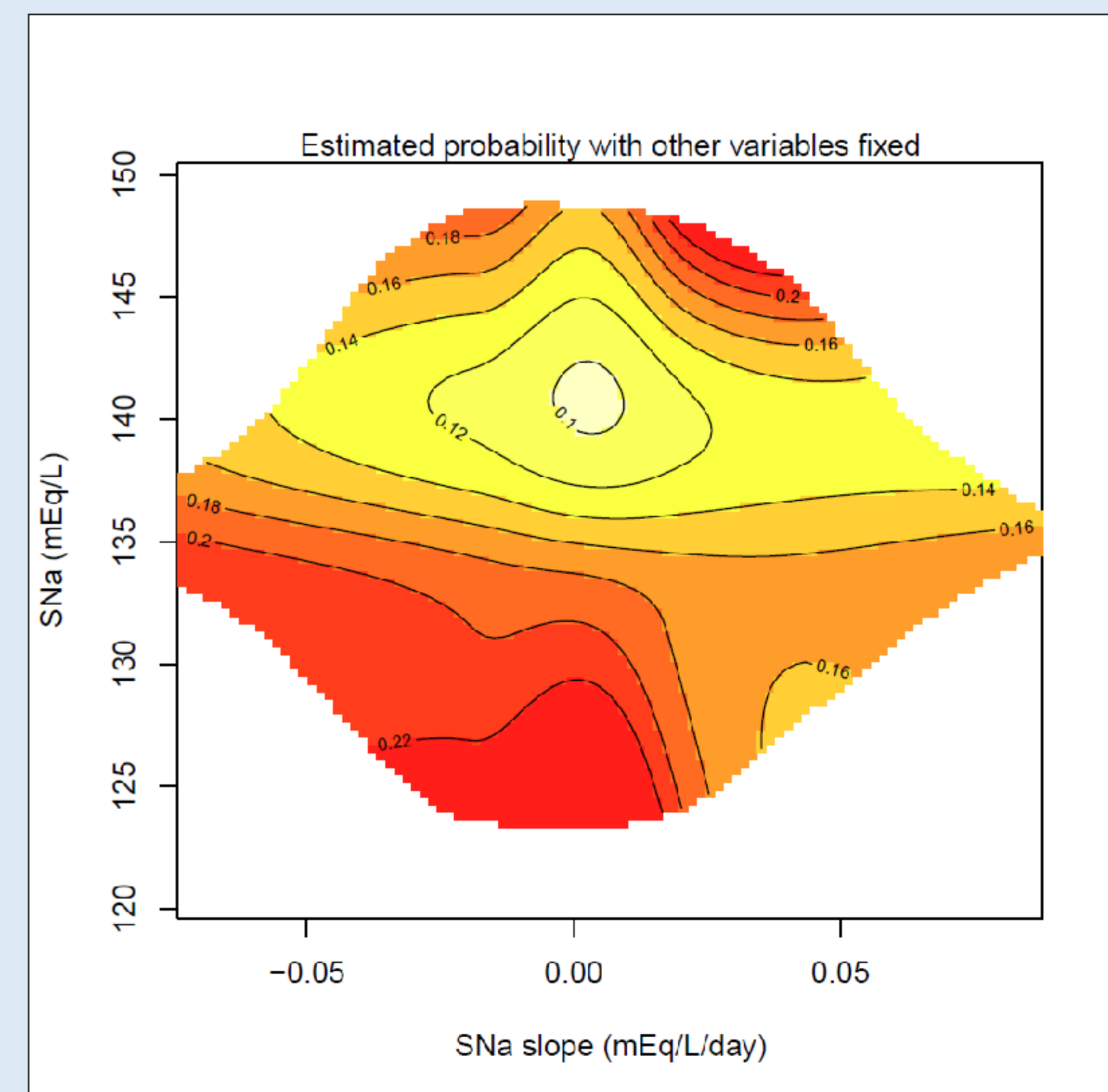


Figure 2: Contour plot of the estimated probability of death as a function of SNa⁺ and SNa⁺ slope for male, diabetic patients with other continuous variables fixed at their median values

