

LETTER



Paediatric intensive care admission blood pressure and risk of death in 30,334 children

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Dear Editor,

Systolic blood pressure (SBP) is associated with mortality in critically ill children. It is used in mortality prediction models such as the paediatric index of mortality (PIM) and the paediatric risk of mortality score (PRISM). Shann et al. [1] described a U-shaped relationship between SBP on admission to the paediatric intensive care unit (PICU) and mortality in 5695 children in the course of developing the PIM score in 1997. The lowest risk of death was at 120 mmHg, regardless of age; 120 mmHg is above the 99th centile for children less than 2 years. Given that most of the PICU population are <2 years of age, the nadir of 120 mmHg may reflect low mortality in older children or low mortality with supra-normal BP. We sought to test this association in children according to age. We hypothesized that there would be a U-shaped association between blood pressure and mortality, but that the nadir would be lower than previously described.

In this retrospective cohort study, we determined the relationship between SBP on admission to PICU and risk-adjusted mortality in four PICUs in London, United Kingdom (two general and two cardiac). Infants with a corrected gestational age of <37 weeks at admission were excluded. Data were available for 30,334 children between 2004 and 2018. We described the relationship between mortality and SBP on admission using a 4-knot restricted cubic spline, with knots at 51, 74, 91 and 122 mmHg (5th, 35th, 65th and 95th centiles, respectively) for the under 2-year-old cohort and knots at 70,

95, 112 and 143 mmHg (5th, 35th, 65th and 95th centiles, respectively) for the 2 years and over cohort. The PIM-2 probability of death with the blood pressure component removed was used to risk-adjust the relationship. The risk-adjusted odds ratio of death according to admission SBP is shown in Fig. 1. The lowest risk of mortality was at 70 mmHg in the <2-year-old cohort, and 95 mmHg in the ≥2-year-old cohort (Fig. 1).

The association between admission SBP and mortality was more complex than previously described. Expectedly, the risk of death associated with low SBP on admission was greater than with high SBP, especially in children ≥2 years. Children <2 and ≥2 years show a nadir of risk around the 35th centile SBP for the population. Both nadirs are considerably lower than 120 mmHg used in PIM. Although there is a risk of our model overfitting the data, given the size of our cohort with data from 4 PICUs, this association is likely to be generalizable. Our data do not consider interventions and are limited to a single measurement at admission. However, most children in our cohort had an admission SBP higher than that associated with the lowest risk. Age-associated SBP should be considered in future iterations of PIM. Furthermore, there is need for a large interventional trial, similar to SEPSISPAM in adults, to understand the risk associated with different SBP targets in the ongoing care of critically ill children [2].

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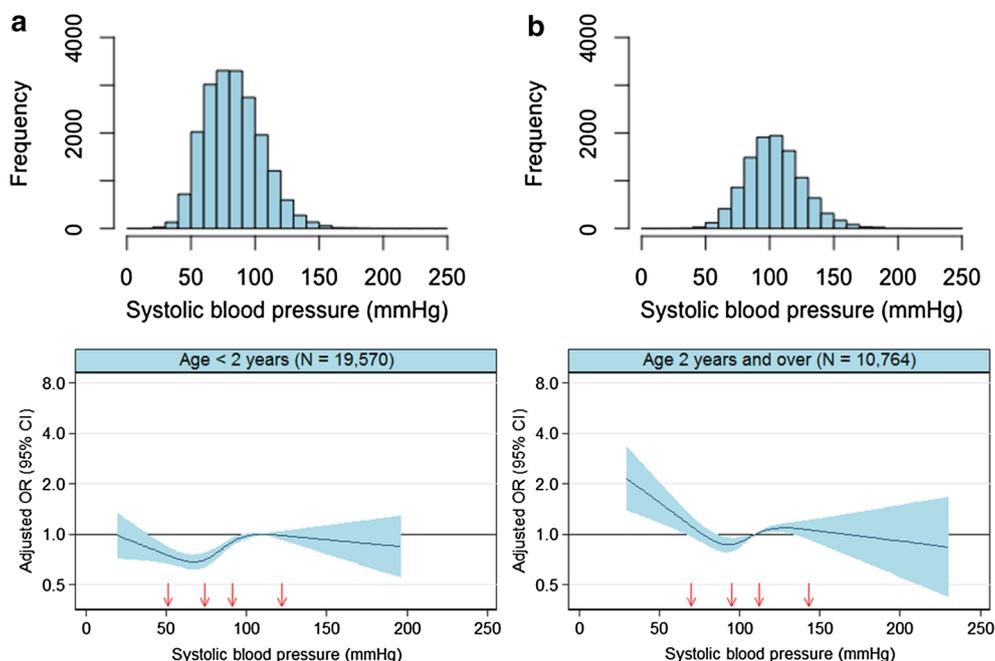


Fig. 1 Systolic blood pressure at admission to ICU in children **a** less than 2 years of age ($n = 19,570$), left, and **b** 2 years and over ($n = 10,764$), right. The top graph shows the frequency histogram of systolic blood pressure for children on admission to ICU. The bottom graph shows the association between admission systolic blood pressure and mortality, adjusted for the paediatric index of mortality with the blood pressure component removed. The adjusted odds ratios on the y-axis are derived from logistic regression following restricted cubic spline transformation of the systolic blood pressure variable. The spline transformation was carried out using four knots at the 5th, 35th, 65th and 95th centiles for each cohort: these are at 51, 74, 91 and 122 mmHg for children < 2 years and at 70, 95, 112 and 143 mmHg, respectively for children 2 years and over (shown by red arrows on the x-axis)

Electronic supplementary material

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Compliance with ethical standards

Conflicts of interest

None to declare.

Ethical approval

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