Is this a normal heart rate?

Validation of evidence-based paediatric heart rate centiles

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Introduction

Both heart rate and respiratory rate are known to be predictive of serious illness in children. However, interpretation of these vital signs in children is complicated by the variation of normal ranges as a child matures.

We have previously published evidence-based centiles for heart rate and respiratory rate in children up to 18 years of age, based on a meta-analysis of results from a systematic review of the literature, but the performance of these centiles has not yet been validated in a representative clinical population [1].

Materials and Methods

Validation of the evidence-based centiles was carried out using the heart rates of 1929 children (0-18 years) attending an Emergency Department in the UK, collected as part of the ERNIE collaboration. The severity of each child’s illness was scored by clinicians, and was used to assess the predictive value of various centiles, with 457 children being identified as having moderate or severe illness.

For each measurement, a z-score was calculated from the evidence-based centiles, and the distributions of scores are compared for different age groups. Various centiles of heart rate and respiratory rate have also been investigated for their ability to predict a variety of patient outcomes. As few children had low heart rates, only the predictive ability of upper centiles were assessed. The predictive ability of the upper limits of heart rate published in the APLS and PALS resuscitation guidelines were also assessed [2,3].

Results

Figure 1 shows that the heart rates in the children attending the ED are generally higher than the normal ranges described by the evidence-based centiles, but follow the same pattern with age. Figure 2 shows that z-scoring reduces the influence of age on heart rate values.

Figure 3 shows the performance of upper centiles (75th–99th) in predicting severity of illness, compared to the upper limits from the APLS and PALS guidelines. The area under the ROC curve was 0.64, showing moderate predictive ability, as would be expected for a single vital sign. Performance of lower centiles was not evaluated due to the small number of children with bradycardia.

Conclusions

Expressing vital signs as z-scores using evidence-based centiles removes much of the age-dependent variation in heart rate. Evidence-based centiles for heart rate show moderate accuracy in predicting the severity of illness in children attending an Emergency Department. The predictive ability of evidence-based centiles is similar to that of consensus-based guidelines.

References