Supplementary methods

Statistical models

The mental health-related emergency deparment presentation and hospitalisation rates and rate ratios in Figs 2−4 of the paper were estimated using parametric multilevel frailty models that allow for multiple presentations or hospitalisations of the same child and the nesting of children within families. These models assume a Weibull hazard function with separate shape parameters for females and males (ρ_f and ρ_m, respectively), and have the general form:

$$h_{ij}(t) = \rho t^{\rho-1}\exp\left(\alpha + X_{ij}\beta + u_i + v_{ij}\right)$$

$$\rho = \rho_f^{s_{ij}}\rho_m^{1-s_{ij}}$$

where $h_{ij}(t)$ is the hazard function for child j in family i, t is age, s_{ij} is an indicator variable equal to 1 for females and 0 for males, X_{ij} is a row vector of explanatory variables (including the exposure of interest and covariates), β is a column vector of regression coefficients, and $u_i \sim N(0, \gamma_u^2)$ and $v_{ij} \sim N(0, \gamma_v^2)$ are random effects for families and children, respectively. Shape parameter values smaller than 1 indicate that the emergency department presentation or hospitalisation rate decreases with increasing *t*, whereas values greater than 1 indicate an increasing presentation or hospitalisation rate. Note that the shape parameter values for females and males were assumed to be equal in the models used to estimate the rate ratios in Figs 3 and 4 (i.e., in these models $\rho_f = \rho_m = \rho$). For the models used to estimate emergency department attendance and hospitalisation rates (those in Fig. 2), the explanatory variables X_{ij} included an indicator variable equal to 1 for females and 0 for males only.

Emergency department presentations and hospitalisations starting prior to recruitment were excluded from the analyses, and children were considered to be at risk of a presentation or admission only when they were not already receiving hospital care for a mental health problem (see Fig. S1). Given r_{ij} at-risk periods for child j in family i, the data likelihood is given by:

$$L = \prod_{i=1}^{C} \prod_{j=1}^{n_i} \prod_{k=1}^{r_{ij}} \left(\rho t_{ijk2}^{\rho-1} \phi_{ij}\right)^{\delta_{ijk}} \exp\left[-\left(t_{ijk2}^{\rho} - t_{ijk1}^{\rho}\right)\phi_{ij}\right]$$

where at-risk period k begins at age t_{ijk1} and ends at age t_{ijk2}, ϕ_{ij}=exp$\left(\alpha + X_{ij}\beta + u_i + v_{ij}\right)$, C is the number of participating families, n_i is the number of children in family i, and δ_{ijk} is an indicator variable equal to 1 if at-risk period k ends with a mental health-related emergency department presentation or hospitalisation and 0 if it ends with censoring (see Fig. S1; Duchateau et al., 2003; Duchateau and Janssen, 2008).

All models were fitted using the MCMC procedure in SAS ver. 9.3 (SAS Institute, Cary, NC, USA), specifying $N(0, 10^4)$ priors for α and the coefficients in β, and Uniform$(0,100)$ priors for ρ_f, ρ_m, γ_u, and γ_v.

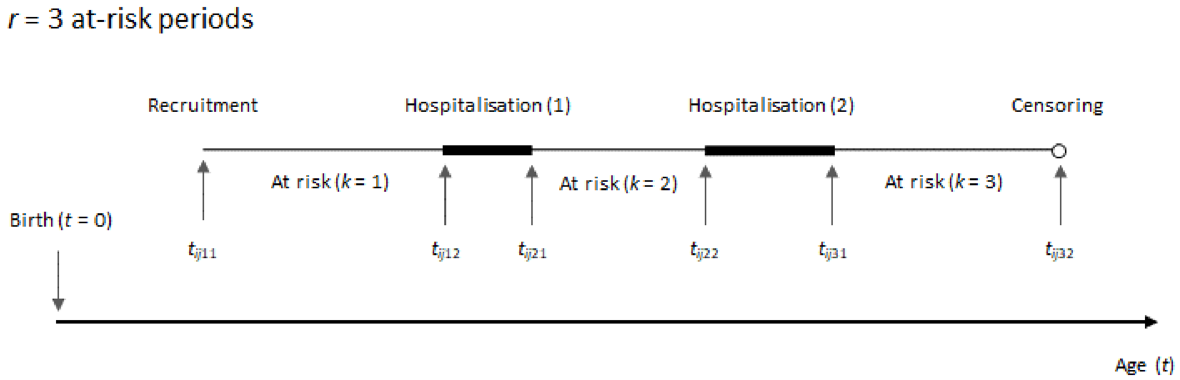

Fig. S1. Example event history for a child j from family i hospitalised twice for a mental health problem during follow-up (where the follow-up period begins with recruitment at age t_{ij11} and ends with censoring at age t_{ij32}). Each of the $r = 3$ at-risk periods k begins at age t_{ijk1} and ends at age t_{ijk2}.

References

Duchateau, L., Janssen, P., Kezic, I., Fortpied, C., 2003. Evolution of recurrent asthma event rate over time in frailty models. Appl. Statist. 52, 355–363.

Duchateau, L., Janssen, P., 2008. The frailty model. Springer, New York.