where "men die more regularly", which he attributed to London's "fumes, steams and stenches". In the east Asia-Pacific region, gender differences in childhood development varied according to family socioeconomic status and, in some settings (such as Mongolia), by location (rural *vs* urban).

Both Graunt's and Weber's analyses have shown the value of rigorous methodological analysis of gender and its association with health, development, and life chances. Weber's findings of gender differences favouring girls will be as surprising to some people as Graunt's findings must have been to his contemporaries when they discovered that women lived longer than men. The paucity of gendered analyses to inform global health priorities represents, to use Graunt's language, a longstanding and persistent "vice" that needs urgent redress.

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We declare no competing interests. The views expressed in this paper represent those of the authors and not UNAIDS.

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# Free play and children's mental health

The growing crisis in children's mental health in the UK is widely recognised. Data from children's charities, including Childline and the UK National Society for Prevention of Cruelty to Children, have shown substantial and worrying increases in demand for their support, with Childline reporting a 36% increase from 2013 to 2016 in calls from children seeking help for serious mental health issues. A 2016 report from Public Health England estimated that 695 000 children in England aged 5–16 years (ie, 10% of all children in England) had a clinically significant mental health illness. The conditions reported included anxiety, depression, conduct disorders, self-harm, and suicidal feelings. As the report described in some detail, such conditions are "a leading cause of health-related disabilities in [children and young people] and can have adverse and long-lasting effects", including drug abuse, criminality, and a life expectancy of 16–25 years less than the general population. However, what this report and much of the policy response lack is a serious consideration of the contribution that positive changes in children's life experiences might have had. Such an analysis might lead to valuable approaches to prevention of mental health problems.

One particular change that has been investigated in this context concerns the amount and quality of free time that children have to engage in their own, self-initiated activities and play. A range of available evidence indicates that free time use has greatly changed in the past few generations. A report written for the UK National Trust, for example, stated that the area where children are allowed to roam unsupervised around their homes has shrunk by 90% since the 1970s. At the same time, changes in education policy have substantially restricted the amount of learning done through play and increased pressures on children at school, with very high levels of stress related to examinations reported.[1] A comprehensive anthropological study[2] of the decline in children's opportunities for free play over the past half century in the USA explicitly linked this decline to a parallel increase in mental health problems.

Studies have focused on the relationship between children's free play opportunities and their mental health. These studies have also investigated the environmental and social factors supporting and inhibiting play, the consequences of play deprivation for mental health, and the effectiveness of play in

For more on **increases in calls to Childline** see https://www.theguardian.com/society/2017/feb/06/rise-calls-childline-mental-health-issues-prompts-call-action

For the **2016 report from Public Health England** see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575632/Mental_health_of_children_in_England.pdf

For the **report for the UK National Trust** see https://www.nationaltrust.org.uk/documents/read-our-natural-childhood-report.pdf

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therapeutic treatments of mental health conditions. I have done a more comprehensive review of this research,[3] and here I will highlight the overall nature of the evidence available.

Studies of factors supporting play and mental health have focused on children's formation of secure emotional attachments and on the role of stress. Extensive evidence has connected the formation of secure emotional attachments early in a child's life to healthy brain development, the regulation of emotions, the ability to show empathy, the ability to form emotional relationships (including friendships with others), emotional resilience, and to playfulness. Children's playfulness, in turn, has been shown to have a central role in the formation and maintenance of friendships, which are of crucial importance for healthy social and emotional development.[4]

Secure emotional attachments have been shown to be fundamental in supporting children's ability to cope with stress and anxiety. Several studies in this area have made the important distinction between stress that is toxic, and stress that is positive. Children with insufficient emotional support and in relentlessly stressful situations arising from poverty, malnourishment, parental stress, or inadequate parenting are substantially more likely to feel toxic stress. Unsurprisingly, this type of stress is associated with mental health problems and low amounts of play.[5] Conversely, children living in emotionally supportive and stimulating environments that nevertheless contain elements of uncertainty, or so-called positive stress, are more likely to be playful and emotionally resilient. So-called risky or adventurous outdoor play, in which children are allowed a degree of autonomy in their choice of play, is also an important contributor to positive stress. A systematic review published in 2015,[6] found consistent evidence of the contribution of this type of free play to children's physical and mental health. In adventurous outdoor play, children can challenge themselves, test out their limits, and learn to self-regulate their emotions.

Data concerning the consequences of play deprivation on children's mental health have mostly come from animal studies, mainly with mice and rats, that used neuroscientific techniques to show that play deprivation results in the underdevelopment of important areas of the prefrontal cortex.[7] However, there are some studies with children subjected to severe maltreatment, such as the children institutionalised in Romanian orphanages[8] in the 1980s. These studies, paralleling the animal studies, reported deficient growth and function of several key brain regions and atypically repetitive or brief play behaviours.

Because a lot of these data are restricted by the difficulty of isolating the effects of playfulness (or its absence) on mental health from the broader environmental factors involved in children's development, evidence of the effectiveness of play in treatments of mental health conditions is the most compelling.[9] For example, a study of the introduction of a structured play regimen in an Indian orphanage[10] reported highly significant gains on motor, cognitive, and social function measures, while the children remained in the deprived environment provided by the orphanage. A 2017 review[11] showed that use of play therapy in children with autism led to improvements in building friendships, social interactions and social competence, family relationships, coping, and reductions in the time spent playing alone.

Play is sometimes dismissed as trivial. However, a review of the data regarding the role of play in mental health suggests that children's natural playfulness might have some crucially important functions for healthy physical and mental development. Professionals working in childcare, education, and paediatrics need to be aware of the importance of children's play, in all its many forms, and how opportunities for playful experiences can be supported in domestic, educational, and therapeutic settings. Parents and other caregivers need to be made aware of the importance of providing

opportunities for their children to play freely. Evidence of a lack of typical play development can be a key indicator of serious and potentially damaging mental health difficulties. At the same time, therapeutic approaches geared towards children with mental health difficulties can often benefit from the inclusion of practices designed to support and encourage children's free, autonomous play.

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The PEDAL Research Centre is primarily funded by the LEGO Foundation, an independent philanthropic foundation that advocates learning through play. I have undertaken several specific projects for this Foundation, supporting research that they are funding and providing literature reviews of academic research in the area of play, education, development, and learning.

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# Towards greater efficiency in neonatal clinical research

The worry that clinical research is often inefficient and wasteful is not new. Clinical trials in their conventional form are expensive and labour intense, and the time from conception to completion usually spans many years. The reliable detection of meaningful treatment effects usually requires large sample sizes, and hence national or international collaboration, further adding to the expense and complexity. Coupled with the small number of academic positions for child health in the UK and around the world,[1] it is perhaps unsurprising that many studies are never done and many uncertainties in everyday clinical care persist. This situation does not serve children well. A direct result is that much neonatal and paediatric practice is not based on high-quality evidence, leading to wide variation in services, care, and outcomes.

One approach that we believe would serve patients better was pioneered in paediatric practice, is internationally recognised, and has been hugely successful. We refer to the Medical Research Council UK (MRC) Acute Lymphoblastic Leukaemia (UKALL) trials,[2] which we participated in as junior doctors. These revolutionised care and outcomes for children with acute leukaemia by investigating incremental changes to chemotherapy regimens in sequential randomised trials. These trials were so successful that cure is now the expectation for many childhood leukaemias. A revolutionary aspect of the UKALL trials was that clinicians clearly and openly communicated to parents and young people that it was unknown whether the existing or new regimen was better and, crucially, that randomisation was the ethically and clinically correct solution to this problem. This gave each patient the same chance of receiving the (unknown) better option, and in turn, led to a culture where randomised allocation to treatment options was seen as a crucial component of high-quality care.


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We want to replicate this model, which was so successful in paediatric oncology, more widely across neonatal and paediatric care. The organisational framework to conduct large, efficient trials in neonatal medicine largely already exists in the UK. All National Health Service (NHS) neonatal units in England, Scotland, and Wales are part of a voluntary UK Neonatal Collaborative and provide consent for predefined data from their neonatal electronic patient records to be extracted at regular intervals and deposited into the National Neonatal Research Database (NNRD). The data extracted comprise the Neonatal Data Set, an approved NHS Information Standard; this set includes outcome measures and