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## Building Blocks for Our Children - The Secrets of Our Hormone System.

### Who am I?

I am a holistic paediatrician with 40 years NHS experience, a post-doctoral endocrine subspecialist and educator at Great Ormond Street Hospital, and associate professor in paediatric neuroendocrinology – the study of hormones in the developing brain.

20 years ago I pioneered a 'beacon' neuroendocrine service to support the mental health, growth, education and adolescent development of children surviving cancer and brain tumours. I still advocate for this cohort who - having reached adulthood for the first time - are the voice of the charity I founded in 2020 [www.successcharity.org.uk](http://www.successcharity.org.uk) 'Life After Cure'.



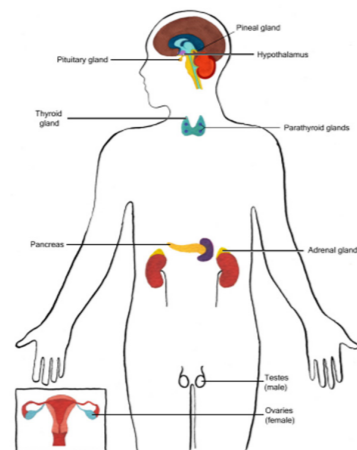
I am also a mother. To embark on parenthood, one unknowingly benefits from a highly evolved and balanced hormone control system. However, it is almost always involved where 'health' is somehow compromised.

### Children are our Future

Children today will live long futures. So, investing in the building blocks they need to grow up strong, happy, healthy and independent is worthwhile. My patients are testimony to the 'plasticity' and adaptability of the young body and brain. This resilience makes it all too easy to overlook evolving difficulties and miss the developmental window of opportunity to provide support.

We must stay alert to abnormalities of growth, weight, puberty, thirst, vision. Keeping a record of weight and height on every birthday, on the paediatric centiles [www.rcpch.ac.uk/resources/uk-who-growth-charts-2-18-years](http://www.rcpch.ac.uk/resources/uk-who-growth-charts-2-18-years) is the best way to check they are healthy, tracking the same parallel trajectory, and seeking advice if they diverge.

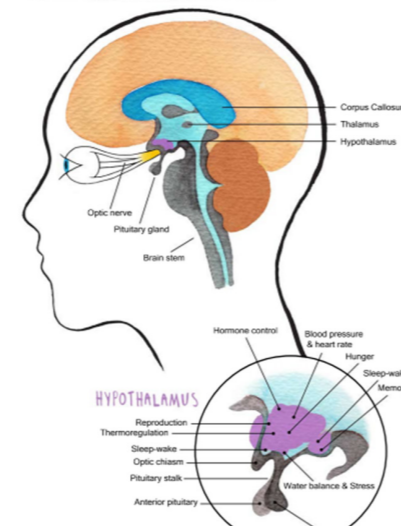
### THE ENDOCRINE SYSTEM



**What are hormones? We blame them for challenging adolescent behaviours, pre-menstrual tension, fatigue, obesity, stress, falling in love; but there is more to be thankful for.**

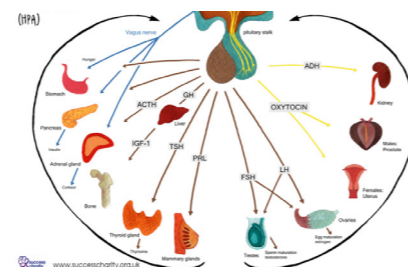
**Without them we would not grow, thrive, sexually mature and reproduce, or even survive. The endocrine system is primitive, highly evolved and 'genius'. It is our body's physiological, messaging system, vital to our wellbeing, who we become, and indeed to life itself.**

### HUMAN DIENCEPHALON



**The hypothalamus is a tiny gland, deep in the midbrain, close to our eyes and barely visible on an MRI scan. It is connected by a stalk to the pituitary gland. Together they form the 'Hypothalamo-Pituitary Axis' (HPA) - a central 'post office' receiving and delivering the body's 'letters'.**

**The hypothalamus processes stimuli, (light and dark, temperature, danger, stress, hunger, thirst, emotion), sending hormones (blood-borne messages) in a downstream waterfall, through the pituitary gland and onwards to each of the body's glands (letterboxes).**



**These hormone 'letters' deserve replies, duly sent back to the HPA in a circular, perfectly balanced system. Blood hormone levels change, adapting to different circumstances, in just the right amounts at just the right time.**



### How does illness affect the HPA?

The HPA is amazingly robust. But any maldevelopment or harm (eg by traumatic brain injury, infection or tumour) can have subtle or devastating consequences.

**Any chronic illness**, as in famine or war, 'pauses' the HPA developmental processes so nature can concentrate on health recovery. This is why delayed growth and puberty complicate brittle asthma and type 1 diabetes, and why anorexia nervosa and post-viral fatigue can arrest puberty or reduce stress hormone (cortisol) levels respectively, spontaneously improving on recovery.

**Rare HPA developmental abnormalities, cysts and tumours** can be so small as to have no symptoms, but larger abnormalities cause growth, thyroid and pubertal hormone deficiencies over time. Headaches and visual disturbance arise from increased pressure on the brain. Wider disruption of all hormones can be life-threatening.

**Hormone producing HPA tumours** are very rare in childhood but can emerge at adolescence and provoke excess growth (gigantism), abnormalities of puberty (prolactinoma and pituitary germ cell tumours) and weight (Cushing's disease).

**The body's wider target glands** may be compromised from birth, injury (including cancer therapy) infection, autoimmune and genetic diseases, whose developmental consequences may be severe. Replacement

therapy is restorative and highly effective.

### Four Developmental Phases of Growth Across the Body and Brain

**In the womb and for the first year**, head growth is greater than body growth. If this early nutrition-dependent growth is compromised, head growth is maintained at the expense of lower weight and shorter height. By the same token, overfeeding will make a baby taller, but the price is lifelong obesity and a harmful pre-diabetes disposition. Too much sugar in today's western diet is to blame for much of the childhood obesity epidemic' and the tall, heavy, young adults in the USA and UK today.

**From two years of age**, growth hormone, pulsing during sleep, controls growth along an individual trajectory (centile), determined by parental stature. Mothers worry about ensuring children are well-fed, but nutrition has little influence on growth now. Weight gain remains comparatively low until puberty.



**At puberty**, sex steroids and a doubling of growth hormone, increase muscle and bone mass, weight and height, secondary sexual characteristics and reproductive organs and fuse the bony growth plates. The adolescent growth spurt is greater and three years later in boys than in girls, so from an identical height at 11 years, girls have the height advantage at secondary transition, their growth stopping at 14-15

years, whilst boys are eventually 13cm taller at 17-18 years. Even the 2nd centile, shortest boys will thus end up taller than 60% of women, but may warrant review at 13-14 years to prevent further discrepancy caused by pubertal delay.

**Completion of growth and puberty**, and reproductive capacity, is marked by the onset of regular periods in girls and beard growth in boys. However, bone density and peak frontal brain growth - responsible for 'executive' planning functions controlling our judgement and personality - continue to accrue under the influence of the same hormones until the age of 20 to 25 years. These high energy processes coincide with increased emotional and intellectual demands. Thus this is a vulnerable time for fatigue, eating, gender identity and mental health disorders and an opportunity for extra rest, fresh air, 'mindfulness' and vitamin D.



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