HISTORIAL REVIEW

Helen Mackay and anaemia in infancy—then and now

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Born in Inverness in 1891, with both of her parents from Highland families, Helen Marion Macpherson Mackay had strong Scottish roots, but it was also possible to recognise her as a product of her school, Cheltenham Ladies College. She went on to study medicine at the Royal Free Hospital and qualified in 1914. She decided to become a paediatrician and after completing some posts in London went to Vienna at the end of the first world war to study rickets under the guidance of Professor Pirquet at the University Kinderklinik.

Rickets was common in young infants in Vienna but she was surprised to find that anaemia was almost universal and became interested in finding the cause. It was recognised that anaemia was common in infants who were given artificial feeds but the reason was not clear. Anaemia and rickets were often found together and some paediatricians thought that they might have a common cause. Part of her work in the 1920s was to show that light therapy, which was very much in vogue at the time, had no effect on anaemia. It was known that iron deficiency was a cause of anaemia in infancy but there were no soundly based studies on the epidemiology and the prevalence of anaemia in infancy, no reliable figures for normal haemoglobin concentrations in infancy, and therefore no agreement on the definition of anaemia in this age group. So it was against this background that Helen Mackay's work took place. Having shown that many of the anaemic infants in Vienna responded to iron, she came back to London to work at the Queen's Hospital, later to be called the Queen Elizabeth Hospital, and made more systematic studies on anaemia in infancy.

Helen Mackay worked as a consultant paediatrician in the east end of London until her retirement in 1959; she died in 1965. She recognised the impact of social conditions on child health and carried this conviction into her working life by setting up clinics for mothers and babies in the community. Her clinical work at the Queen's Hospital, the Mother's Hospital, and in the community was inevitably centred on the disadvantaged and her research essentially an extension of this work. Dressed in the familiar brown suit she wore every day, with her

remarkable memory, complete commitment to the care of young children, and insistence on the highest standards of clinical note keeping, Helen Mackay created an indelible impression on all who worked with her and was held in awe as well as affection by the staff of the Queen's Hospital. She was by nature reserved and formal, rarely indulged in small talk, and belonged to an age when colleagues were seldom addressed by their Christian names. In her own home she and her companion, Miss Lorel Goodfellow, showed that formality and affection could go together by invariably calling each other 'Mackay' and 'Goodfellow'. Her infrequent holidays were usually taken in Scotland or on the moors where she liked to walk and enjoy ornithology.

Helen Mackay had many honours bestowed on her in recognition of her work as a paediatrician and for her research contributions into anaemia and infant nutrition. Two of her achievements demonstrate her importance in British paediatrics and at the same time remind us of the belated entry of women into the male bastions of medicine: in 1934 she became the

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first woman fellow of the Royal College of Physicians and in 1945 was one of the first women to be elected to the British Paediatric Association. One hundred years after her birth, new work on the untoward effects of iron deficiency on young children has drawn us again to the importance of her research, the soundness of which is demonstrated by how little her conclusions need to be altered in the light of our knowledge today. Respected clinician, a pioneer who brought paediatric care into the community, and unforgettable personality: these are some of the memories of those who knew her, but to generations of paediatricians to come Helen Mackay will be remembered for laying down the foundations of our knowledge of iron deficiency anaemia in infancy.

Prevalence and cause of anaemia in infancy

In the east end of London in the 1920s the prevalence and severity of iron deficiency in infancy were similar to that in the most deprived areas of the developing world today. Without iron treatment the haemoglobin concentrations of more than 90% of infants failed to reach 80% (approximately 110 g/l) at any time between 6 months and 2 years of age,¹⁻³ whereas 81% of those who took iron regularly achieved haemoglobin concentrations above this level. How much change has there been since the 1920s? In 1971, David Burman reported that infants in Bristol who were not given iron supplements had similar haemoglobin concentrations to those who were given iron in Helen Mackay's study.⁴ He showed that routine iron supplementation for infants was not justified in present day Britain. However, when disadvantaged groups are examined separately the position is not quite so good.⁵ Iron deficiency anaemia is still common in infants in inner city areas and in one study 18% of the white and 26% of Asian infants were found to have iron deficiency anaemia.⁶ Helen Mackay recorded the family income and social conditions of the infants in her study but was unable to compare systematically the prevalence of iron deficiency in infants from different backgrounds. One such study in the USA showed that the prevalence of iron deficiency and anaemia in young infants was three times greater in poor compared with more affluent groups of society but this difference became much less noticeable after 3 years of age.⁷

Diet and iron deficiency

Infants in the 1920s were weaned late and iron fortified infant feeds were not available. Breast feeding was continued much longer than is the practice in the developed world today and artificial feeds consisted of reconstituted powdered cows' milk, sometimes with added carbohydrate, but with no added iron or vitamins. Solid feeds play an important part in the prevention of iron deficiency but Helen Mackay shared with today's investigators the difficulty of making an accurate assessment of the impact of different types of solid feeds on iron deficiency

in infancy. Her most important dietary finding was to show that haemoglobin concentrations were higher in breast fed infants throughout most of infancy. Modern studies have confirmed that breast fed babies are more likely to maintain normal serum ferritin concentrations in the first six to nine months of life than those fed with unmodified cows' milk.⁸ The disadvantage of giving unmodified cows' milk in the first year of life was confirmed in a study in which haemoglobin and serum ferritin concentrations were found to be lower in infants fed with unmodified cows' milk compared with those who were fed with an iron supplemented formula milk.⁹

'The percentage of iron retained is apparently less in a baby fed on cows' milk . . . than one fed on human milk'.¹⁰ Helen Mackay correctly identified the most important reason for the better iron status in breast fed infants. About 50% of the iron in breast milk is absorbed compared with about 10% in cows' milk.¹¹ Most of the modern infant formulas contain added iron to compensate for poor absorption. About one third of infants fed with 'doorstep' cows' milk have been shown to loose blood in the stools, which may contribute to the risk of iron deficiency.¹²

Low birth weight and iron deficiency

Helen Mackay showed that the initial drop of haemoglobin as well as the degree of anaemia after six months was more profound in low birthweight infants. This second drop can be prevented by iron supplementation,¹³ which should be given to low birthweight infants after 1 month of age whereas the initial fall has a nadir at 6-8 weeks of age and is not due to any nutritional deficiency. Helen Mackay correctly attributed the increased risk of iron deficiency to low stores of iron at birth in low birthweight infants and to the demands of growth.

Non-haematological effects of iron deficiency

Helen Mackay found that infants who were given iron supplements had fewer documented infections, gained more weight, and were noticeably more healthy than those who were not given iron. The existence or otherwise of harmful non-haematological effects of iron deficiency has undoubtedly been the most controversial aspect of iron deficiency over the last 60 years. Until recently the sceptics seemed to hold sway but over the last 10 years there has been an impressive group of studies showing that treatment of iron deficiency improves the development and growth of young children and makes them happier.¹⁴ The effect of iron treatment on the risk of infection is still a matter of debate¹⁵ with the evidence suggesting that it may reduce the risk of infection or have no effect in non-malarial areas and possibly increase the risk in some malarial parts of the world.

Normal haemoglobin in infancy and the diagnosis of iron deficiency anaemia

'The normal haemoglobin percentage in the

blood in infancy from four months upwards is at least 80%'¹ (approximately 110 g/l³). Helen Mackay was the first person to try to define the lower limit of normal haemoglobin throughout infancy by examining a group of children who had been supplemented with iron. Her definition of anaemia in this age group closely resembles that accepted by the World Health Organisation 40 years later.¹⁶ In her own hospital she encouraged her staff to give an iron sulphate preparation, affectionately known as 'Mist Helen Mackay', to all children suspected of having iron deficiency anaemia. Since that time tests such as serum ferritin and transferrin saturation have been introduced to help with the diagnosis of iron deficiency but a trial of iron treatment remains the 'gold standard' test of iron deficiency anaemia in infancy.

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