tional leaflet published by the National Society for the Prevention of Cruelty to Children and the Department of Health, *Handle with Care*, is a starting point for educating parents and other carers. This leaflet can be used by midwives and health visitors as a basis for individual work with parents, particularly targeting those considered to be most at risk.

We stated that shaking a baby is dangerous, and this is recognised by paediatricians. The purpose of the editorial and the campaign by the National Society for the Prevention of Cruelty to Children was to alert carers to the dangers of shaking infants and to offer help and support in dealing with stressful situations engendered by an infant's incessant crying. The hope is that, if carers are alerted when they are not stressed, they will refrain from inflicting injury during stress.

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- 1 Duhaime A-C, Gennarelli TA, Thibault LE, Bruce DA, Margulies SS, Wiser R. The shaken baby syndrome. A clinical, pathological, and biomechanical study. *J Neurosurg* 1987;66: 409-15.
- 2 Ommaya AK, Hirsch AE. Tolerances for cerebral concussion from head impact and whiplash in primates. *J Biomech* 1971;4:13-21.
- 3 Ommaya AK, Faas F, Yarnell P. Whiplash injury and brain damage: an experimental study. *JAMA* 1968;204:285-9.
- 4 Kleinman PK. Diagnostic imaging in infant abuse. *AJR* 1990;155:703-12.
- 5 Showers J. Shaken baby syndrome: the problem and a model for prevention. *Children Today* 1992;21(2):4-6.

Maternal haemoglobin and birth weight in different ethnic groups

Methods used do not support conclusions

EDITOR,—We have three comments on the methods used by Philip Steer and colleagues in their study of the relation between maternal haemoglobin concentration and birth weight.¹

Firstly, Steer and colleagues repeatedly refer to the fall in haemoglobin concentration. This implies comparison of two values. They use only the lowest haemoglobin concentration and are therefore relating birth weight to minimum haemoglobin concentration and not to the fall in haemoglobin concentration.

Secondly, they base their analysis on the lowest haemoglobin concentration during the pregnancy without taking into account the gestation at which haemoglobin concentration was estimated. Surprisingly, they do this despite emphasising the importance of the relation between gestation, expansion of plasma volume, and haemoglobin concentration.

Thirdly, they take no account of multiple pregnancies, in which low birth weight and premature labour are often seen in conjunction with low haemoglobin concentrations. Multiple pregnancies should have been excluded from the analysis, and this should have been made clear in the paper.

We think that the conclusion in the abstract that "the magnitude of the fall in haemoglobin concentration in pregnancy is related to birth weight" is not supported by the methods used.

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Study's conclusions are implausible

EDITOR,—I note that Philip Steer and colleagues used the word association to describe the relation they found between haemoglobin concentration and birth weight.¹ In their discussion, however, they suggested that haemoglobin concentration might be a determinant of birth weight. I refer, for example, to the statement: "There is a theoretical risk that increasing haemoglobin concentration might actually reduce birth weight and do harm," albeit that they do not claim that there is consistent evidence.

I am interested that Steer and colleagues thought causality in that direction was the most likely explanation. Would not a more plausible explanation be that a large fetus will have a greater iron requirement and therefore cause anaemia in the mother? And that, conversely, a small fetus will be less demanding on the mother's iron stores? Also, the fetus is not the only player here. Another important consideration is the effect that a low haemoglobin concentration has on the general wellbeing of the mother. Even if a low haemoglobin concentration did lead to high birthweight babies, and it is difficult to imagine the mechanism for this, the decision not to give iron supplements would have to be balanced against the presence of any symptoms of anaemia in the mother.

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Lower haemoglobin may be the result rather than the cause of larger fetuses

EDITOR,—Philip Steer and colleagues studied the relation between maternal haemoglobin concentration in pregnancy and birth weight and suggested that their results show that low haemoglobin concentrations are advantageous in improving fetal growth.¹ They even suggested a theoretical risk that treatment to improve haemoglobin concentrations may be detrimental to the fetus. They do not discuss the alternative explanation that lower haemoglobin concentrations are the result rather than the cause of larger fetuses. Expansion of plasma volume, and therefore haemodilution, is greater in association with larger fetuses, and this may account for the relation Steer and colleagues observed.

Garn *et al*, who studied a large cohort of American women,² previously described a U shaped relation between the lowest maternal haemoglobin concentration in pregnancy and poor outcome in the form of preterm delivery, low birth weight, or perinatal death. The lowest incidence of stillbirths occurred in association with haemoglobin concentrations between 90 g/l and 110 g/l. It was not clear from their study whether high haemoglobin concentrations were harmful or simply a reflection of poor plasma volume expansion in pregnancies that were failing to thrive.

Murphy *et al* found a similar curved association between haemoglobin concentrations at booking and perinatal mortality, but their results do not exclude the possibility that high haemoglobin concentrations at this early stage are the result of poor haemodilution.³ The increase in plasma volume begins from the start of pregnancy, and by 12 weeks' gestation a significant rise, averaging 12%, has already occurred.⁴

The direction of the association between maternal packed cell volume and poor pregnancy outcome needs to be determined as low haemoglobin values have been linked with subsequent raised blood pressure in childhood,⁵ which may be

a precursor of adult disease. This will be possible only by prospective follow up of women from before the start of pregnancy through to delivery, with examination of the relation between changes in plasma volume and haemoglobin concentrations and the outcome of pregnancy.

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- 1 Steer P, Alam MA, Wadsworth J, Welch A. Relation between maternal haemoglobin concentration and birth weight in different ethnic groups. *BMJ* 1995;310:489-91. (25 February.)
- 2 Garn SM, Ridella SA, Petzold AS, Falkner F. Maternal hematologic levels and pregnancy outcomes. *Semin Perinatol* 1981;5: 155-62.
- 3 Murphy JF, O'Riordan J, Newcombe RG, Coles EC, Pearson JF. Relation of haemoglobin levels in first and second trimesters to outcome of pregnancy. *Lancet* 1986;i:992-5.
- 4 Whitaker PG, Lind T. The intravascular mass of albumin during human pregnancy: a serial study in normal and diabetic women. *Br J Obstet Gynaecol* 1993;100:587-92.
- 5 Law CM, Barker DJF, Bull AE, Osmond C. Maternal and fetal influences on blood pressure. *Arch Dis Child* 1991;66:1291-5.

Figure for lower end of range of maximal haemoglobin is too low

EDITOR,—The U shaped curves of low birth weight and preterm delivery by maternal haemoglobin concentration described by Philip Steer and colleagues¹ were established by Garn *et al*.² The two groups agree about the decline in reproductive efficiency when maternal haemoglobin concentration is above about 140 g/l (or packed cell volume 0.41), observations which need to be known by all obstetricians.

The two groups differ importantly, however, over what is the lower end of the range of maximal haemoglobin concentration during pregnancy. The curve of Garn *et al* showed reducing percentages of favourable pregnancies when lowest maternal packed cell volume was below 0.32 (haemoglobin concentration about 110 g/l) in white Americans or below 0.29 (haemoglobin concentration about 100 g/l) in black Americans. In contrast, Steer and colleagues reported a maximum mean birth weight and the lowest incidences of low birth weight and preterm delivery in white women with the lowest haemoglobin concentrations of 85-105 g/l.

In 83 Australian multigravidae (predominantly white women) who had not been anaemic in previous pregnancies we also found that birth weight was significantly inversely related to the haemoglobin concentration at first antenatal attendance and the lowest haemoglobin concentration recorded.³ These low concentrations were recorded in early or mid-pregnancy (the mean period of gestation at first attendance was 19 weeks and at the time of lowest haemoglobin concentration 31.1 weeks).

As the adverse effects of maternal anaemia on the fetus are rapidly reversed by successful treatment,⁴ and as even mild maternal anaemia from any cause is associated with compensatory placental hypertrophy,⁵ we postulated that high birth weight of infants whose mothers had experienced anaemia earlier in pregnancy could be explained by the persistence of large placentas after the correction of anaemia. All the haemoglobin estimations by Steer and colleagues were before half way through the third trimester. They do not say when in gestation the lowest haemoglobin concentrations occurred; if these were fairly early in pregnancy and were followed by haematinic supplementation or treatment the conclusion that haemoglobin concentrations in the range of 85-105 g/l during pregnancy are optimal cannot be accepted.

Many black women (27 241, 46% of the total) were included in the American series,² and an ethnic difference emerged that was not apparent with the small number from ethnic minority groups in the British series.¹ The range of optimal

packed cell volumes with a lower limit in black American women may be due to the high frequency of α thalassaemia in people of African descent and to total compensation for lifelong slightly lower haemoglobin concentrations.

Steer and colleagues consider that it "remains possible that genuine anaemia . . . has adverse consequences on fetal growth and long term outcome." Obstetricians and others working in developing countries know well the severe consequences of maternal anaemia on placental size, fetal growth, length of gestation, fetal nutrition, infant morbidity and mortality, and maternal morbidity and ultimately mortality.⁴ It remains the duty of obstetricians to try to bring maternal haemoglobin concentration into the optimal range for pregnancy. Evidence suggests that the optimal range is 110-140 g/l rather than the lower values proposed by Steer and colleagues.

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- 1 Steer P, Alam MA, Wadsworth J, Welch A. Relation between maternal haemoglobin concentration and birth weight in different ethnic groups. *BMJ* 1995;310:489-91. (25 February.)
- 2 Gam SM, Keating MT, Falkner F. Hematological status and pregnancy outcomes. *Am J Clin Nutr* 1961;34:115-7.
- 3 Fleming AF, Martin JD, Stenhouse NS. Obstetric outcome in pregnancies complicated by recurrent anaemia, with observations on iron and folate metabolism, bacteriuria and pre-eclampsia. *Aust N Z J Obstet Gynaecol* 1974;14:204-9.
- 4 Fleming AF. Tropical obstetrics and gynaecology. I. Anaemia in pregnancy in tropical Africa. *Trans R Soc Trop Med Hyg* 1989;83:441-8.
- 5 Godfrey KM, Redman CW, Barker DJ, Osmond C. The effect of maternal anaemia and iron deficiency on the ratio of fetal weight to placenta weight. *Br J Obstet Gynaecol* 1991;98:886-91.

Author's reply

EDITOR,—To answer the questions of Sarah Vause and colleagues in reverse order, I can reassure them that the data given in our paper referred only to singleton pregnancies. This information was included in our original submission but was inadvertently omitted when we revised the paper to answer points made by referees. I am grateful for the chance to put the record straight.

The St Mary's maternity information system records the lowest haemoglobin concentration but not the gestation at which the lowest value occurred. The references we quoted in our paper make it clear that most of the expansion in plasma volume (which is reflected in the fall in haemoglobin concentration) has occurred by 20-24 weeks' gestation and there is comparatively little change thereafter. Thus, estimation of haemoglobin concentration at any gestation after 24 weeks is likely to show a similar relation with birth weight.

Finally, although we referred mainly to the relation of the lowest haemoglobin concentration to birth weight, I confess that we assumed several times that the lowest concentrations showed the largest falls from prepregnancy values. This assumption is consistent with the longitudinal studies of plasma volume in pregnancy that we cited in our paper. I accept that without measuring prepregnancy haemoglobin concentrations it cannot be proved. If the assumption were not true, however, the average fall in haemoglobin concentration would be the same (or greater) with a high pregnancy haemoglobin concentration as with a low (95-105 g/l) concentration. This would lead to the intriguing conclusion that women with higher than average haemoglobin concentrations when not pregnant would have smaller babies than their peers with lower values. I am not aware of any obvious physiological basis for such a hypothesis. To test it would require a large number of women to have their haemoglobin concentrations

measured before they became pregnant; such a study would probably present insuperable logistical problems.

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Outcomes of neonatal intensive care

EDITOR,—Christine Sanderson and D M B Hall support the concept of improving the availability of data on the outcome of neonatal intensive care.¹ Their suggestion that this can best be achieved by each unit employing "someone trained in counselling, child development and psychological assessment to follow up its graduates" seems, however, to be against the current trend.

The Audit Commission initiated this debate in the report *Children First* after being unable to obtain even the most straightforward population based data on outcomes.² It suggested that simple information (Is the child blind? Is the child deaf?) should be collected routinely for all babies who had received intensive care. The report mentioned by Sanderson and Hall was an attempt by the relevant professional groups to reach consensus on both what should be included in such a minimum dataset and the optimum timing of the collection of data.³ To fulfil the challenge issued by the Audit Commission it was considered essential that all infants who had received intensive care, not simply those in whom problems might be expected, should be included in any review of outcome. Although clinical data may sometimes give a strong indication of subsequent disability, prediction continues to be unreliable.

Given the mobility of the population and the current role of community paediatric services, it is appropriate that health staff based in the community should monitor the later health status of those who receive neonatal intensive care. In Sanderson and Hall's region (Trent) each health district still tries to examine all children, whether or not they have required intensive care, between 1½ and 2½ years of age. These reviews already aim to collect all the items of the minimum dataset except the date on which the child's mother left full time education.¹ The information is recorded and stored centrally but rarely used. Surely it is sensible to try to refine and focus this activity instead of inventing a new system at further cost.

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- 1 Sanderson C, Hall DMB. The outcomes of neonatal intensive care. *BMJ* 1995;310:681-2. (18 March.)
- 2 Audit Commission. *Children first: a study of hospital services*. London: HMSO, 1993.
- 3 Johnson A. *Disability and perinatal care: measurement of health status at two years*. Oxford: National Perinatal Epidemiology Unit, 1994.

Water births

Could saline in the pool reduce the potential hazards?

EDITOR,—I have recently attended four water births; three went smoothly, but in one the baby had some difficulty breathing and was admitted to the special care baby unit, where he had a convulsion and was found to have a low sodium concentration. Inhalation of water was thought to be a likely cause for this, and the diagnosis on

discharge was freshwater drowning. Apparently the inhalation of even a small quantity of fresh water can cause appreciable haemodilution and the kind of problem experienced by this baby (who made a full recovery).

The proponents of water birth argue that a baby cannot inhale water even after the head is delivered because of chest compression in the birth canal. I do not believe this: on several occasions I and midwives have heard a baby whose head has been delivered make an attempt to cry. If the same happened under water a small amount of fresh water would be inhaled.

If the contents of the birthing pool were not fresh water but isotonic saline then presumably this haemodilution effect could be avoided. In the most recent water birth I attended, the patient was a qualified pharmacist, who told me that the birthing pool held 909 litres of water, to which the addition of 9 kg of salt would produce a solution of isotonic saline. I have discussed the idea locally with colleagues, who can see no obvious flaw in it, and I would appreciate others' comments.

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*We sent Dr Barry's letter to an expert, asking for his comments.

EDITOR,—The suggestion that salt should be added to make the water isotonic in a water birth would give rise to few theoretical objections by those who insist on having a water birth and would probably have an appeal, following the experience of C N Barry. A convulsion due to hyponatraemia in a baby who has been immersed in fresh water is important. The phenomenon is well recognised in the so called "drownproofing" of infants, in which well meaning but misguided people attempt to teach children under the age of 12 months to swim. Under these circumstances the infants can be trained to struggle across up to 10 m. They are submerged for an appreciable part of this distance and swallow a considerable amount of water. Convulsions have been reported after lessons and are known to be associated with similar hyponatraemia to that seen after the swallowing of large quantities of fresh water with subsequent haemodilution.

Nevertheless, it would be wrong to add salt in this way, or indeed in any way to encourage the practice, until experimental studies with animals were undertaken. Any experimental trials by well meaning adults that use infants or children as research subjects are unacceptable until double blind experimental studies have been reported and the procedure is found to be safe.

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Trends in sudden infant death

The few remaining sudden infant deaths are likely to be explicable and avoidable

EDITOR,—E A Gilman and colleagues report a dramatic fall in the rate of the sudden infant death syndrome in England and Wales after a peak in 1988.¹ This particularly occurred after the Department of Health issued advice at the end of 1991 that babies should not be placed to sleep prone; this instituted the "back to sleep" campaign. I have reported a campaign in the Scarborough district to avoid overdressing, overwrapping,