# What is the normal range of blood glucose concentrations in healthy term newborns?

Report by
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You are the attending neonatal consultant. It is 6 pm on a Friday after a busy week on the unit. A rather flustered midwife appears from the postnatal ward with a baby and two anxious parents. The baby is full term and appropriately grown, following a normal vaginal delivery and just 8 hours old. Mum has been attempting to breast feed but the baby is reported to have been "not feeding well" and "jittery". There are no prenatal risk factors for sepsis. Your examination of the baby is normal—he is now not "jittery".

A capillary heel prick blood test (Medisense) done on the postnatal ward has given a blood glucose reading of 2.6 mmol.

Because this result is perceived to be abnormal (low), one of the neonatal trainees has suggested to the parents that he may need admission to the neonatal unit. As she has had three previous babies, the mother was hoping for an early (six hour) discharge from hospital.

The midwife asks you to "sort out the situation".

Some hours later, the laboratory plasma glucose result (taken at the same time as the Medisense capillary sample) is available. This result is 3.4 mmol/l.

The mother agreed to stay overnight with the baby on the postnatal ward, received breast feeding support, and was discharged home next morning. No further blood samples were taken. A phone call to the mother on day 3 confirmed that the baby remained well and fully breast fed.

### Structured clinical question

In otherwise healthy newborn babies, what is the normal range of blood glucose, in the first days of life?

### Search strategy and outcome

[newborn] AND [blood glucose OR hypoglycaemia] AND [Exp cohort studies]

### Search results

Cochrane Library: no relevant studies found.

Primary sources (Medline): 3 observational studies.

See table 3.

### CLINICAL BOTTOM LINE

- The normal range of blood glucose is around 1.5–6 mmol/l in the first days of life, depending on the age of the baby, type of feed, assay method used, and possibly the mode of delivery.
- Up to 14% of healthy term babies may have blood glucose less than 2.6 mmol/l in the first three days of life. Lowest concentrations are more likely on day 1.
- There is no reason to routinely measure blood glucose in appropriately grown term babies who are otherwise well. "Jitteriness" is a mostly benign finding.
- Feeding difficulty should be overcome with education, promotion, and support for breast feeding.

### Commentary

There was remarkable agreement between the results of these three studies in spite of different populations (UK, Denmark, and India) and different methods of assay (whole blood glucose: microenzymatic and glucose dehydrogenase photometric methods; plasma glucose: glucose oxidase method).

Breast fed babies have statistically significantly lower blood glucose concentrations (mean 3.6 mmol/l; range 1.5–5.3) in the first week of life, compared to formula fed babies (mean 4.0 mmol/l; range 2.5–6.2).

Breast fed full term babies with low blood glucose concentrations produce ketones and other fuels as an adaptive mechanism.

Jitteriness is an extremely common and usually benign finding in otherwise well term newborns.[1] In a study of 102 full term babies with "jitteriness",[2] sucking on the examiner's hand stopped the tremor in over 80%. Of the 18 babies whose tremor continued, only five had hypoglycaemia and 13 had hypocalcaemia

In our case, the difference between the Medisense heel prick (2.6 mmol/l) and the laboratory plasma glucose of 3.4 mmol/l, highlights the poor predictive value of reagent strips to detect true hypoglycaemia (PPV 0.18 for blood glucose of <2.0 mmol/l). Use of reagent strips will on average wrongly diagnose hypoglycaemia in one out of four babies who are in fact normoglycaemic.[3]

If a baby appears well but "jittery", he or she should be examined carefully and have a suckling stimulation test. If he or she fails this test, blood assay of calcium and glucose should be done. Blood glucose of less than 1.5 mmol/l should prompt further investigation in any baby (well or otherwise).

### REFERENCES

1 D'Harlingue AE, Durand DJ. Recognition, stabilization and transport of the high-risk newborn. In: Klaus MH, Fanaroff AA, eds. *Care of the high risk neonate.* Philadelphia: Saunders, 1993:62–85.

**Table 3** Blood glucose in newborns

| Citation | Study group | Study type (level of evidence) | Outcome | Key result | Comments |
|---|---|---|---|---|---|
| Hawdon *et al* (1992) | 156 term infants, breast or bottle fed | Observational, cross sectional (1b) | Assay of whole blood glucose, gluconeogenic precursors, and ketone bodies from day 1 to day 6 | 12% had blood glucose <2.6 mmol/l, days 1–3 | Range of blood glucose was <1.5 to 6.2 mmol/l<br>Lowest levels were on day 1<br>Widest range on day 2 |
| Hoseth *et al* (2000) | 223 term infants, exclusively breast fed | Observational, cross sectional (1b) | Assay of whole blood glucose between 1 and 96 hours of age | 14% had blood glucose <2.6 mmol/l | Range of blood glucose was 1.4 to 5.3 mmol/l. Lowest levels were on day 1 |
| Diwakar and Sasidhar (2002) | 220 healthy term infants, AGA, exclusively breast fed | Observational, longitudinal (1b) | Assay of plasma glucose at 3, 6, 24, and 72 hours of age | 14% had blood glucose <2.6 mmol/l | Range of blood glucose was 1.3 to 8.3 mmol/l<br>Levels similar at each timepoint |

2 Linder N, Moser AM, Asli I, *et al*. Suckling stimulation test for neonatal tremor. *Arch Dis Child* 1989;**64**:44–6.
3 WHO. *Hypoglycaemia of the newborn: review of the literature*. Geneva: WHO, 1997:30–1.
4 Hawdon, JM, Ward-Platt MP, Aynsley-Green A. Patterns of metabolic adaptation for preterm and term infants in the first neonatal week. *Arch Dis Child* 1992;**67**:357–65.
5 Hoseth E, Joergensen A, Ebbesen F, *et al*. Blood glucose levels in a population of healthy, breast fed, term infants of appropriate size for gestational age. *Arch Dis Child Fetal Neonatal Ed* 2000;**83**:F117–F119.
6 Diwakar KK, Sasidhar MV. Plasma glucose levels in term infants who are appropriate size for gestation and exclusively breast fed. *Arch Dis Child Fetal Neonatal Ed* 2002;**87**:F46–F48.

# POSTCARD FROM DOWN UNDER

## Desperately seeking asylum

Opening the newspaper you read about a nation holding 2700 people in detention without trial. Of these, 600 are children, and of these, 50 are children not accompanied by a member of their family. Amnesty International alleges that staff refer to inmates by number instead of name, that solitary confinement is used as punishment even for children, and that tear gas is used without discrimination to quell disturbances.

The year is 2002, the month January and the country, not some pariah state where these sorts of statistics provoke a sigh and the thought "Oh no, not again", but Australia. The people are the illegal immigrants.

The camps are private facilities, run by a company called Australian Correctional Management, itself a division of the American company Wackenhut Correctional Corp. Enclosed by razor wire, the camps are in some of Australia's most inhospitable spots. The other side of the wire is desert with daytime temperature far in excess of body temperature, prompting children to ask a visiting child psychiatrist "Doesn't Australia have flowers?".

The Australian Government is proud of its record on accepting immigrants—and certainly for a relatively small population it accepts a fairly large number of refugees. But it is with the illegal immigrants—and the government view that this is an issue of internal politics—where the controversy lies. The electorate, for the most part, are behind the government on this issue. In the November 2001 Australian general election, Prime Minister John Howard, who until an immigration crisis involving the MV Tampa had been very low in the opinion polls, was returned to power with a reasonable majority. Most commentators agree that this election was won and lost on the issue of immigration. Interestingly, this was not because the opposition disagreed with government policy, since it did not. Time and again the opposition was nearly indecently eager to endorse the government view, and in doing so seeming to take its political lead from them.

There is one Australian view which holds that Australia is a country isolated in the middle of Asia, and that any weakness in immigration policy will open the floodgates. There is another view, most frequently expressed by the founder of the One Nation political party, Pauline Hanson, which holds that this has already begun. One Nation polled well in the 1998 General Election—the Australian electoral system giving small but significant clout to the lesser parties. It did much less well in 2001, and there is yet another view which suggests that this is because the views of One Nation were, by this time, being adequately expressed by the mainstream political parties.

Words are powerful things—a fact too easily undermined by the over frequent use of that old cliché about the pen and the sword. Politicians are extremely familiar with this power. They use phrases like "illegal immigrant" or "queue jumper"—referring to the government insistence that for each "illegal" given refugee status, they will accept one less via legal channels. The media—some of it, at least—takes up these phrases, and they are heard repeated in tea rooms and taxis. These, instead of the differently evocative "desperate refugees", "fleeing families", or even "children". As a letter writer in a newspaper cleverly asked with respect to the queue jumpers: "Where is the queue to escape a burning building?". This writer, along with newspaper columnist Phillip Adams were, for me, an bedrock of sanity in the confusion I felt trying to reconcile this cold hearted attitude with the genuine warmth of character and generosity I found to be an essential feature of nearly every Australian I met. The Australian view that they live in the Lucky Country, and that everyone deserves a Fair Go are parts of the national mantra, but something was amiss here.

The Australian Government says that 80% of the detainees get a primary decision on their status within 15 weeks of incarceration. Amnesty International reckons the average detention time to be eight months. In any case, some 80% of those detained are eventually found to be genuine refugees. In the meantime, it is hard to decide which is more distressing: children on hunger strikes, self mutilating, and threatening suicide; or the radio shock-jock saying that he didn't mind the hunger strikes because this was saving him, a tax payer, the cost of paying for their food.

The physical isolation of Australia from much of the developed world means that they don't have a very clear appreciation of how the rest of the world perceives them—either positively or negatively. This helps to reinforce their opinion that the rest of the world doesn't understand their special circumstances. The question that the rest of the world needs to ask, and to keep on asking, is: "What special circumstances make it reasonable to imprison a child?".

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