Key messages

- There has been a large, unexplained increase in non-Hodgkin's lymphoma in recent decades
- It has been hypothesised that greater exposure of the population to sunlight, which can cause systemic immune suppression, may have contributed to the increase in non-Hodgkin's lymphoma
- The geographical pattern of non-Hodgkin's lymphoma in England and Wales tends to match that of solar ultraviolet radiation
- Exposure to sunlight may increase the risk of non-Hodgkin's lymphoma
- Risks might be reduced by adoption of a more cautious approach to sun exposure

Greater exposure to sunlight could also contribute to the excess risk of non-Hodgkin's lymphoma in several outdoor occupations such as farming, forestry, and construction,⁹⁻¹⁰ although other factors, including chemical exposures, might also be important.¹¹ Enhanced exposure to ultraviolet radiation could also be a factor in the raised incidence of non-Hodgkin's lymphoma that has been observed in Vietnam War veterans in the United States. It has been hypothesised that this might be the result of exposure to the herbicide Agent Orange, but risk did not differ by level of exposure to the suspected chemicals, although it was associated with length of service in Vietnam.³⁴ Since the whole of Vietnam is within the tropics, service personnel based there could have been exposed to higher levels of ultraviolet radiation than if they had remained in the United States.

If exposure to solar ultraviolet radiation is a cause of non-Hodgkin's lymphoma it might be possible to reduce risk by encouraging people to limit their exposure to the sun. However, increases in the amount of ultraviolet B radiation reaching the surface as a result of stratospheric ozone depletion²⁷ could add to risk.

The climatology data used to estimate ultraviolet levels were supplied by the Climate Impacts Link Project (Department of the Environment Contract PEC7-12-96).

Funding: This study was carried out in the Centre for Social and Economic Research on the Global Environment, which is funded by the Economic and Social Research Council.

Conflict of interest: None.

- 1 Devesa SS, Fears T. Non-Hodgkin's lymphoma time trends: United States and international data. *Cancer Res* 1992;52(suppl):5432-40S.
- 2 Cartwright R. Changes in the descriptive epidemiology of non-Hodgkin's lymphoma in Great Britain. *Cancer Res* 1992;52(suppl):5441-2S.
- 3 Greiner TC. Epidemiology of non-Hodgkin's lymphoma: a review. *Diagn Oncol* 1994;4:26-32.
- 4 Weisenberger DD. Epidemiology of non-Hodgkin's lymphoma: recent findings regarding an emerging epidemic. *Ann Oncol* 1994;5(suppl 1):S19-24.

- 5 Filipovich AH, Mathur A, Kamat D, Shapiro RS. Primary immunodeficiencies: genetic risk factors for non-Hodgkin's lymphoma. *Cancer Res* 1992;52(suppl): 5465-7S.
- 6 Kinlen L. Immunosuppressive therapy and acquired immunological disorders. *Cancer Res* 1992;52(suppl):5474-5S.
- 7 Levine AM, Shibata D, Sullivan-Halley J, Nathwani B, Brynes R, Slovak ML, et al. Epidemiological and biological study of acquired immunodeficiency syndrome-related lymphoma in the county of Los Angeles: preliminary findings. *Cancer Res* 1992;52(suppl):5482-4S.
- 8 Mueller NE, Mohar A, Evans A. Viruses other than HIV and non-Hodgkin's lymphoma. *Cancer Res* 1992;52(suppl):5479-81S.
- 9 Scherr PA, Hutchison GB, Neiman RS. Non-Hodgkin's lymphoma and occupational exposure. *Cancer Res* 1992;52(suppl):5503-9S.
- 10 Pearce N, Bethwaite P. Increasing incidence of non-Hodgkin's lymphoma: occupational and environmental factors. *Cancer Res* 1992;52(suppl):5496-500S.
- 11 Zahm SH, Blair A. Pesticides and non-Hodgkin's lymphoma. *Cancer Res* 1992;52(suppl):5485-8S.
- 12 Holford TR, Zheng T, Mayne ST, McKay LA. Time trends of non-Hodgkin's lymphoma: are they real? What do they mean? *Cancer Res* 1992;52(suppl):5443-6S.
- 13 Hartge P, Devesa SS. Quantification of the impact of known risk factors on time trends in non-Hodgkin's lymphoma incidence. *Cancer Res* 1992;52(suppl):5466-9S.
- 14 Cartwright R, McNally R, Staines A. The increasing incidence of non-Hodgkin's lymphoma (NHL): the possible role of sunlight. *Leuk Lymphoma* 1994;14:387-94.
- 15 Glass AG, Hoover RN. The emerging epidemic of melanoma and squamous cell skin cancer. *JAMA* 1989;262:2097-3000.
- 16 Doll R. Progress against cancer: an epidemiological assessment. *Am J Epidemiol* 1991;134:675-88.
- 17 Goettsch W, Garssen J, de Gruij FR, van Loveren H. UV-B and the immune system. *Thymus* 1993;21:93-114.
- 18 Adami J, Frisch M, Yuen J, Glimelius B, Melbye M. Evidence of an association between non-Hodgkin's lymphoma and skin cancer. *BMJ* 1995;310:1491-5.
- 19 Newton R. American data refute ultraviolet hypothesis. *BMJ* 1995;311:750.
- 20 Sasieni P, Bataille V. Ultraviolet light is unlikely explanation for association. *BMJ* 1995;311:749.
- 21 Vickers M. Association may be iatrogenic. *BMJ* 1995;311:750.
- 22 Adami J. Author's reply. *BMJ* 1995;311:750-1.
- 23 World Health Organisation. *Ultraviolet radiation. Environmental Health Criteria* 160. Geneva: WHO, 1994.
- 24 Swerdlow A, dos Santos Silva I. *Atlas of cancer incidence in England and Wales 1968-85*. Oxford: Oxford University Press, 1993.
- 25 Mo T, Green AES. A climatology of solar erythema dose. *Photochem Photobiol* 1974;20:483-96.
- 26 Barrow E, Hulme M, Jiang T. *A 1961-90 baseline climatology and future climate change scenarios for Great Britain and Europe. Part 1: a Great Britain baseline climatology*. Norwich: Climatic Research Unit, 1993.
- 27 Madronich S, McKenzie RL, Caldwell MM, Björn LO. Changes in ultraviolet radiation reaching the Earth's surface. *Ambio* 1995;24:143-52.
- 28 McKinney PA, Alexander FE, Cartwright RA. Epidemiology of non-Hodgkin's lymphoma in parts of England and Wales (1984-88). *Leuk Lymphoma* 1991;4:123-30.
- 29 Office of Population Censuses and Surveys. *Census 1971. England and Wales. Economic Activity County Leaflets*. London: HMSO, 1975.
- 30 Kirkpatrick CS, Lee JAH, White E. Melanoma risk by age and socio-economic status. *Int J Cancer* 1990;46:1-4.
- 31 Elwood JM, Whitehead SM, Davison J, Stewart M, Galt M. Malignant melanoma in England: risks associated with naevi, freckles, social class, hair colour, and sunburn. *Int J Epidemiol* 1990;19:801-10.
- 32 Østerlind A, Tucker MA, Stone BJ, Jensen OM. The Danish case-control study of cutaneous malignant melanoma. II. Importance of UV-light exposure. *Int J Cancer* 1988;42: 319-24.
- 33 Elwood JM, Gallagher RP, Hill GB, Pearson JCG. Cutaneous melanoma in relation to intermittent and constant sun exposure: the western Canada melanoma study. *Int J Epidemiol* 1985;35:427-33.
- 34 Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam. *Arch Intern Med* 1990;150:2473-83.

(Accepted 26 January 1996)

Blood money: blood donors' attitudes to changes in the New Zealand blood transfusion service

Philippa Howden-Chapman, John Carter, Nicholas Woods

Blood is an unusual product in a market economy: donors give it freely to strangers. Titmuss concluded that if this gift was commercialised, donors would feel less inclined to donate blood without payment and would face incentives not to disclose diseases.¹ The opposing view is that the most efficient way of rationing a scarce product like blood is to put a price on it and let a market develop in which it can be traded.²

In 1993 a purchaser-provider split was introduced into the New Zealand health service. The Blood Transfusion Service was embedded in the new hospital organisations, crown health enterprises, which were required to be profit driven.³ A National Blood Transfusion Trust was set up to preserve the gift relationship and to ensure that there is no profiteering in blood. Nevertheless, the costs associated with collecting, processing, and distributing blood products can be passed on to providers, who are later reimbursed. This study aimed to examine the motives of New Zealand blood donors and whether the changes in the blood transfusion service might affect their donations.

Method and results

After obtaining ethical committee approval we asked 345 consecutive blood donors attending the Wellington Transfusion Centre (and its mobile units) to fill in a questionnaire: 338 (98%) did so. Most were long term

Wellington School of Medicine, PO Box 7343, Wellington South, New Zealand
Philippa Howden-Chapman, senior lecturer in public health
John Carter, senior lecturer in haematology
Nicholas Woods, medical student

Correspondence to:
Dr Howden-Chapman.

BMJ 1996;312:1131-2

Table 1—Blood donors' responses to actual and hypothetical transfusion scenarios

	Agree (%)	Maybe (%)	Disagree (%)	Don't know (%)
Because of health service user charges I have reconsidered donating blood	10	10	74	6
If the health services recover only the cost of processing blood, so that a profit is not made, I would continue to give my blood	83	7	6	4
If a profit was made from selling blood products I would not continue to give my blood	41	11	23	25
If I were offered expenses to compensate for my time in giving blood I would not accept it	47	26	7	20
If some blood donors in New Zealand were paid for giving blood I would still volunteer to give blood	76	7	6	11
If I were offered money for giving blood I would still want to give blood	75	7	11	7
If people were paid to give blood the quality collected may be reduced	48	23	20	9

donors (87% had been donating for over a year and almost half for over 10 years). Just over half were men (52%), but Europeans (93%, $P<0.0005$), professionals and managers (48%, $P<0.0005$), and the employed (97%) were overrepresented compared with the general population. Most people (89%) gave blood for a "general desire to help people." Other reasons were to repay a transfusion given to someone they knew (8%) or to themselves (5%), or because of future need or a family tradition.

Donors were asked about actual and hypothetical situations in relation to the reformed transfusion services (table 1). There was opposition to profit being made from blood, with 52% of donors unlikely to continue donating if this occurred, and even cost recovery alone was opposed by 13%. As a result of the introduction of user charges 20% of donors had reconsidered their donations; 71% of donors expressed concern about the quality of blood in a more commercial service.

Comment

Opinions of New Zealand donors, who have experienced the privatisation of many public sector agencies and the introduction of user charges for health care, are more pecuniary and divided than those of Titmuss's donors. Increasingly being asked to bear the costs of services, many donors would find it acceptable to be offered payment. While some donors voiced concerns about the introduction of market mechanisms in the blood service, most had long established patterns of donating, which they valued. As suggested by some authors, it may be possible, and desirable, to combine altruistic and pecuniary motives in the donor

population.^{4,5} If even a small number of donors cease donating, however, there are policy implications. Donor numbers have been hard to maintain, and even a 10% reduction would severely compromise the service. We are aware that a higher proportion of donors than usual have resigned since the introduction of the 1993 health reforms. This group is the subject of a separate study.

A recent report from Iowa suggests that blood quality is not compromised when rigorously selected paid donors are used, but most of our donors had serious concerns about quality in a commercially driven blood service. If this concern is shared by the general public commercial changes in blood transfusion services may be met with public opposition. Embedding transactions that rely so heavily on altruism in commercial organisations endangers the nature of the gift. Whether there will be compensating factors such as greater efficiency or the attraction of sufficient new, high quality donors is not clear.

We thank the blood donors and transfusion staff for participating in this study.

Funding: Wellington division, New Zealand Cancer Society. Conflict of interest: None.

- 1 Titmuss RM. *The gift relationship: from human blood to social policy*. London: Allen and Unwin, 1971.
- 2 Cooper MH, Culyer AJ. *The price of blood: an economic study of the charitable and commercial principle*. London: Institute of Economic Affairs, 1968.
- 3 Howden-Chapman P. Blood ties: accountability for blood quality in New Zealand. *Health Policy* 1994;27:35-51.
- 4 Von Schubert H. Donated blood – gift or commodity? Some economic and ethical considerations on voluntary vs commercial donation of blood. *Social Science and Medicine* 1994;39:201-6.
- 5 Pozo PR. Paying donors and the ethics of blood supply. *Journal of Medical Ethics* 1994;20:31-5.

(Accepted 5 December 1995)

Low triiodothyronine concentration in preterm infants and subsequent intelligence quotient (IQ) at 8 year follow up

A Lucas, R Morley, MS Fewtrell

Prematurity is associated with clinically important changes in endocrine physiology. We have reported reduced plasma concentrations of many hormones in premature compared with full term infants, including prolactin,¹ testosterone,² and, notably, triiodothyronine.³ Thyroid hormones are critical signals for brain development.⁴ We showed a reduction of 7-9 points in scores in standardised mental and motor development tests at 18 months of age in preterm infants, even after adjustment for potential confounding

factors.³ As cognitive function at 18 months may not reflect later intelligence quotient (IQ), we measured IQ in the same group of preterm infants 7.5-8 years later when scores are likely to reflect adult values.

Subjects, methods, and results

We measured plasma triiodothyronine concentrations longitudinally in 279 infants in samples taken at 1-3 days and 4-7 days and then weekly until the infant was discharged from hospital or weighed 2000 g.³ IQ was assessed in 236 infants (94% of survivors) at 7.5-8 years by means of an abbreviated version of the revised anglicised Weschler intelligence scales for children, which has five subscales and a correlation with full scale IQ of 0.96. In those children whose minimum triiodothyronine concentration was below 0.3 nmol/l³ we found substantial deficits in IQ scores, even after adjustment for birth weight, gestation, sex, and Apgar score at 5 minutes (table 1). The effect was independent of the duration of artificial ventilation.

Infant and Child
Nutrition Group, Medical
Research Council Dunn
Nutrition Unit,
Cambridge CB4 1XJ
A Lucas, head
R Morley, MRC clinical
scientist
MS Fewtrell, MRC training
fellow

Correspondence to:
Professor Lucas.

BMJ 1996;312:1132-3