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A CLEVER COUNTRY – THE HEALTH BENEFITS OF REMOVING LEAD FROM PETROL

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On June 2, 1993 the National Health and Medical Research Council (NHMRC) proclaimed a goal of achieving

"... for all Australians a blood lead level below 10μg/dL. There is a particular urgency in reaching this level in children aged 1-4 years because of the adverse effects on intellectual development".

The NHMRC statement also indicates that to achieve this goal a strategy should be developed which specifically addresses:

- the accelerated reduction of lead in petrol; and
- the increased use of unleaded petrol.

While no date has been set for the achievement of this goal it is unlikely that it can be met in the short term unless steps are taken to accelerate the phasing out of leaded fuel[1]. In this article we review briefly the rationale for the removal of lead additives from fuel, present some data on the relative effectiveness of certain measures and foreshadow policy options to achieve this end.

WHY IS LEAD ADDED TO PETROL?

Lead is added to petrol to increase octane rating and for valve lubrication. Octane rating is a measure of the compression of the petrol-air mixture in a car engine without experiencing "knocking". A higher octane rating ensures higher compression and greater engine efficiency[2].

In Australia unleaded petrol is refined to an octane rating of 92 Research Octane Number (RON), while leaded petrol is refined to 97 RON. Almost all petrol in Australia originates as 92 octane unleaded fuel. The amount of lead added to the petrol depends on the desired octane rating: the more lead added, the higher the octane rating. Consequently, reducing the amount of lead added to petrol reduces the octane rating unless additional octane-enhancing compounds are added.

There is debate as to whether a lower octane fuel can be used in vehicles designed for a 98 or 97 octane fuel specification. It has been suggested that the inappropriate use of lower octane fuel may cause slight engine damage, although the evidence for this is weak.

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Removing lead from petrol

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Some industry experts believe the only likely problem will be a small rise in driver dissatisfaction because of an increase in engine knocking. However, most drivers are unlikely to detect this phenomenon[2].

The amount of lead permitted to be added to petrol in Australia (0.4-0.8 g/L)[3] is high compared with other OECD countries. In the US, Canada and Austria leaded petrol is not permitted. In most EEC countries the level of lead in petrol is 0.15 g/L[3].

In Australia unleaded petrol was introduced in 1986 and since then about 5 per cent of the NSW car fleet a year changes over from using leaded to unleaded fuel as vehicles become redundant. Fifty per cent of the NSW car fleet uses leaded petrol. The NSW Lead Issues Paper predicts leaded petrol will continue to be available until 2005-2010[3].

It is estimated that about one-third of pre-1986 vehicles can fully switch over to using unleaded petrol. Another third of pre-1986 vehicles will be able to run on a mixture of leaded fuel (one tank) to unleaded fuel (three tanks), while the remainder will most likely not be able to use unleaded petrol[4].

WHAT IS THE HAZARD?

There is scientific consensus that levels of blood lead as low as 10-25 µg/dL can cause neurological impairment in preschool-aged children[5,6,7]. The magnitude of this impairment has been estimated as an average loss of 2-3 IQ points for every 10 µg/dL increase in lifetime average blood lead[5]. There is no evidence of a threshold to the effects of lead[5,6,7].

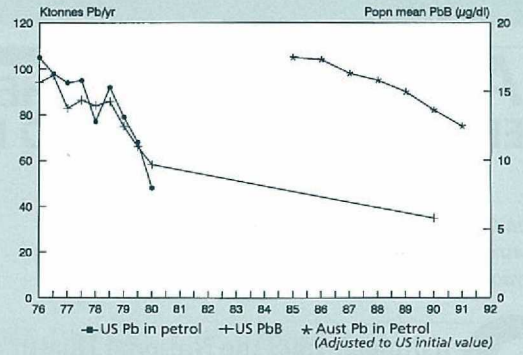
Children absorb lead by ingestion and inhalation through contact with lead particles in soil, dust and air. There is general agreement that for children, the relative contribution to blood lead from ingestion is greater than that from inhalation.

The Australian Bureau of Statistics has estimated that 90 per cent of the lead content in air in urban areas is attributable to leaded petrol emissions[8]. Compounding the problem of environmental lead pollution is the fact that once lead in air has been deposited in soil it becomes cumulative in the environment. It is also difficult and expensive to remove.

Other main sources of lead in urban areas include leaded paint used in older housing and lead from industrial processes. Although there is still uncertainty about the exact contribution of the major sources of lead to environmental levels, it is commonly accepted that removing lead from fuel is an effective means of lowering population mean blood lead levels.

FIGURE 1

COMPARATIVE RATES OF DECLINE OF LEAD IN PETROL IN US AND AUSTRALIA*, AND MEAN BLOOD LEAD IN THE US POPULATION (US PbB)



** The number of kilotonnes of lead additives used in Australia per annum were weighted to equate US tonnages at the time of unleaded petrol policy introduction.*

In the US the phasing out of leaded petrol from 1973 was associated with a significant reduction in the mean population blood lead level from 15.9 µg/dL in 1976 to about 6 µg/dL in 1990[9,10]. Figure 1 illustrates the comparative decline in the amount of lead added to petrol in the US[9] and in Australia, coupled with the parallel decrease in blood lead levels of the US population. In Australia the amount of lead added to petrol has decreased by only 20-25 per cent since 1985 when unleaded petrol was introduced, compared with the US where a 40 per cent reduction was achieved between 1976 and 1980[3].

In addition, a UK study found there was a significant decrease in blood lead concentrations in children and mothers living in both urban and rural settings, with urban children showing a 17 per cent drop in mean blood lead over four years. The only consistent changes in blood lead concentrations for all ages studied occurred in 1985 and 1986 when lead in petrol was reduced by 63 per cent. The authors concluded that the decrease in blood lead levels was due to declining air concentrations after the phasedown of lead in petrol[11].

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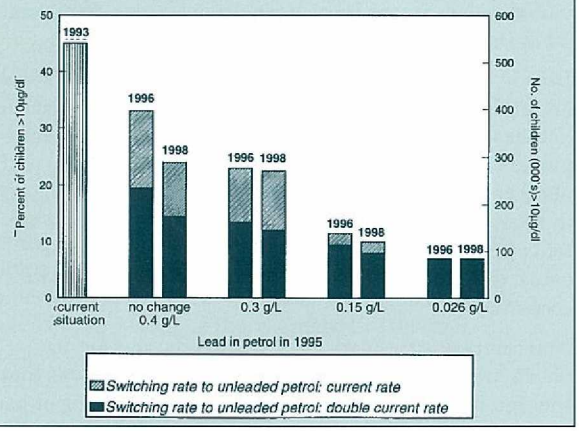
FIGURE 2

NUMBER OF AUSTRALIAN CHILDREN (0-4 YEARS) EXCEEDING THE NH&MRC BLOOD LEAD GOAL



SCENARIOS

On the basis of data collected from Australian surveys conducted between 1975 and 1990, it has been estimated that 45 per cent of preschool-aged children have blood lead levels above 10 µg/dL[12]. However, the prevalence of high blood lead levels is likely to be lower due to declining levels of lead in air since 1985.

If current levels of lead in petrol are maintained, and only 5 per cent of cars a year switch to using unleaded fuel, it is predicted that in 1996 there will still be up to 400,000 children in Australia with blood lead levels exceeding 10 µg/dL[12]. In Figure 2[12], a number of the policy options for the reduction of lead in petrol is illustrated. Clearly, the switchover rate to unleaded petrol will have the greatest effect on the decline in the number of children with blood lead levels above 10µg/dL. However, overseas experience would suggest that even a doubling of the switchover rate would be difficult unless a large price differential were introduced.

IS IT WORTH IT?

As a society we place a high value on children achieving their intellectual potential. Although applying a dollar cost on this value has limitations, there is no doubt that cost and benefit analyses are an integral part of decision making in complex policy issues.

The NSW Environment Protection Authority (EPA) has conducted such an analysis[4], and this will soon be presented to the NSW Government. The analysis considered the costs involved in remedial education and costs of forgone income due to a loss of IQ because of chronic low-level lead poisoning. The benefits of avoiding these outcomes have been weighed against the following factors:

- reducing the lead content of fuel below 0.3 g/L may incur increased refining costs if there is a continuing demand for fuel with an octane rating of 96 RON; and
- the cost associated with increased engine wear in cars which may require a high-octane fuel.

However, there are also savings to industry such as the reduced requirement for buying lead additives as a result of the change to unleaded fuel.

The EPA concluded there is a large net benefit in decreasing lead in petrol. Two main conclusions drawn from the cost-benefit analysis are:

- reducing lead in petrol sooner rather than later will produce the greatest benefits; and
- lead levels should be reduced by as much as is technically possible without incurring significant capital expenditure.

In addition, a recent report to the NHMRC estimated that the likely cost of reducing the amount of lead added to petrol to a level of 0.15 g/L, would be about 2 cents a litre[1].

CURRENT SITUATION

A Lead in Petrol Working Group reporting to the NSW Lead Taskforce is considering the following proposals:

- lead in petrol should be reduced immediately from 0.4 to 0.3 g/L;
- endorsement of the decision made at the national level, that NSW refineries supply leaded petrol with a lead content of 0.2 g/L by the end of 1994 provided that octane demand can be reduced;
- NSW sales data of leaded and unleaded fuel, figures for total tonnage of lead added to petrol, and ambient air data be used to ascertain the short-term impact of the lead in petrol reduction strategy. A blood lead survey will be used to evaluate the effectiveness of the lead in petrol reduction strategy in the long term;
- an education campaign be instituted to encourage owners of pre-1986 cars to switch to using unleaded petrol (for those models which can do so); and
- that further research is required to investigate the effect of using lower octane fuels in pre-1986 vehicle engines and that research is required into the use of alternative octane enhancers.

The NSW Health Department considers reducing lead in petrol is likely to be the most effective means of reducing blood lead of all people living in an urban setting. Furthermore, controlling the hazard at source is the optimal method to guarantee the desired reduction in children's blood lead levels.

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