Australian Government Department of the Environment and Energy Ministerial Forum on Vehicle Emissions

Discussion Paper 'Better fuel for cleaner air'

Response from Cancer Council Australia

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Cancer Council Australia is Australia's peak national non-government cancer control organisation and advises the Australian Government and other bodies on evidence-based practices and policies to help prevent, detect and treat cancer and also advocates for the rights of cancer patients for best treatment and supportive care.

Contact: Paul Grogan, Director, Public Policy and Knowledge Management, Cancer Council Australia: paul.grogan@cancer.org.au (02) 8063 4155

Introduction

Cancer Council Australia welcomes the opportunity to provide comment on the Australian Government Ministerial Forum on Vehicle Emissions Discussion Paper 'Better fuel for cleaner air'.

In Australia, a significant proportion of cancers are the result of lifestyle factors, such as smoking, alcohol-intake, sun exposure, overweight/obesity and lack of exercise[1]. Cancers caused by these lifestyle factors can largely be avoided through individual commitment to healthy choices; however, other cancers that result from exposure to hazardous chemicals at work and to environmental pollution, are unavoidable[2]. These cancers can be totally prevented by regulation. The scope of relevant regulation extends from prohibition, as is the case with asbestos, to incremental harm reduction as may be achieved through the Ministerial Forum on Vehicle Emissions.

Outdoor air pollution is a proven cause of lung cancer, and engine emissions of all types contribute to such pollution[3].

Diesel engine emissions are proven causes of cancer[4]. In Australia, diesel engine exhaust is the second most common carcinogen that workers are exposed to, behind solar UV radiation[5].

Therefore, the Ministerial Forum, which is focused on coordinating a whole-of-government approach to reducing motor vehicle exhaust emissions that harm human health, presents

clear opportunities for policy action to reduce the likelihood of cancers attributable to air pollution, and hence the number of cancers occurring in the Australian community.

General comments

Individuals are exposed to motor vehicle emissions throughout life in a variety of settings, including in the home, in the workplace and in the general environment.

Engine exhausts include exhaust from engines powered by diesel, petrol, and other fuels, although diesel and petrol are the most widely used fuels in combustion engines, and their emissions are comprised of a complex mixture of gases and particulates. Gaseous constituents include oxides of carbon, nitrogen, and sulphur, and low-molecular weight hydrocarbon. The particulates are primarily composed of cores of elemental carbon, traces of metallic compounds and adsorbed organic materials including aromatic hydrocarbons, polycyclic aromatic hydrocarbons (PAH), aldehydes, and nitrogen oxides[4, 6-8]. When inhaled, the small sized particles (usually <1 µm) can penetrate deep into the lungs[7, 9]. While diesel and petrol powered engines emit similar particles, there are differences in both the distribution and surface properties of these particles, suggesting that these exposures may impact differently on human health[10].

The World Health Organization (WHO) International Agency for Research on Cancer (IARC) provides the most definitive determinations of possible carcinogenic activity attributable to chemical, physical or biological agents that are available worldwide. Central to this discussion are the IARC evaluations of outdoor air pollution[3] and diesel and petrol engine exhausts[4].

Outdoor air pollution is a mixture of multiple pollutants originating from various natural and human-derived sources, including motor vehicle emissions. In Australia, a significant proportion of air pollution (approximately 75%) is due to motor vehicle emissions[11]. The IARC classified outdoor air pollution and particulate matter from outdoor air pollution as a Group 1 carcinogen ('Carcinogenic to humans'), based on sufficient evidence of carcinogenicity in humans and experimental animals and strong mechanistic evidence[3]. The findings regarding the carcinogenicity of outdoor air pollution as a mixture, and of particulate matter specifically, was very consistent across epidemiological studies, as well as experimental studies of cancer in animals, and a variety of mechanistic studies related to cancer[3]. In particular, an increased risk of lung cancer was consistently observed in studies including millions of people and many thousands of lung cancer cases from Europe, North America, and Asia[3].

The evidence from epidemiological studies supports a causal association between exposure to diesel engine exhaust and lung cancer. In addition, evidence from many, but not all, available studies has demonstrated an increased risk of bladder cancer as a result of diesel engine exhaust exposure[4]. Therefore, IARC has classified diesel engine exhaust as a Group 1 carcinogen ('Carcinogenic to humans') based on sufficient evidence linking it to an increased risk of lung cancer and limited evidence linking it to an increased risk of bladder cancer[4].

The relationship between petrol engine exhaust and cancer risk was investigated in relatively few epidemiological studies. In addition, in many of these studies there were difficulties separating the effect of diesel and petrol engine exhaust. As a consequence, the evidence for carcinogenicity was determined to be 'inadequate'[4]. With regard to experimental studies of animals that examined the carcinogenicity of condensates of petrol engine exhaust, IARC concluded that the evidence was 'sufficient'[4]. Petrol engine exhaust was also shown to induce DNA damage in a number of test systems. In summary, petrol engine exhaust was classified as a possible human carcinogen (Group 2B) by IARC, based on inadequate evidence in humans and sufficient evidence in experimental animals[4].

A 2015 study was the first to describe the exposure to diesel engine exhaust in Australian workplaces and one of the few recent studies internationally[12]. This study reported that 13.8% of the 2011 Australian workforce was estimated to be substantially exposed to diesel engine exhaust in their current job. Among the 1.2 million people who were estimated to be exposed to diesel exhaust in the workplace, 160 000 (1.8%) were exposed at high levels. Exposure prevalence varied across states, ranging from 6.4% in the Australian Capital Territory to 17.0% in Western Australia[12]. The highest proportion of workers exposed to diesel engine exhaust worked in agriculture, mining, transport, and construction, and in combination, these industries covered 19% of the Australian workforce in 2014[13]. Men (21.7%) were exposed more often than women (5.1%)[12].

Despite being one of the leading causes of cancer mortality in children, relatively little is known about the risk factors for childhood brain tumours[14, 15]. As a significant proportion of childhood brain tumours occur before the age of five, prenatal exposure and early postnatal factors may play a role in their aetiology. Paternal employment in industries involving exposures to PAH, which are formed during incomplete burning of organic substances such as fuel, was first suggested as a risk factor for childhood brain tumors in 1974 and has been observed in a number of studies since[14,16,17].

An Australian case–control study has examined the relationship between childhood brain tumors and parental occupational exposure to engine exhausts[18]. This study demonstrated an association between both maternal and paternal exposures to diesel engine exhaust before a child's birth and an increased risk of childhood brain tumors; however, no clear associations with occupational exposure to petrol and other engine exhausts were found. These results suggest that parental occupational exposure to diesel engine exhaust before a child's birth may increase the risk of childhood brain tumors[18]. An association between paternal PAH exposure and childhood brain tumors has been demonstrated previously, suggesting that PAH may be an important component of diesel engine exhaust in relation to childhood brain tumors[16].

In addition to diesel engine exhaust, other vehicle emissions have been identified as carcinogenic, including benzene and 1,3-butadiene in petrol[19]. Benzene and 1,3-butadiene are known to cause hematopoietic and lymphatic malignancies in occupationally exposed adults[19]. In addition, studies in the US have shown that an increased risk of childhood leukaemia is associated with elevated air concentrations of benzene, with a stronger association observed for acute myeloid leukaemia than for acute lymphoblastic leukaemia[20, 21].

Concentrations of benzene, as well as other vehicle-related pollutants such as carbon monoxide, nitrogen monoxide, ultrafine particles and black carbon, are significantly higher in the immediate vicinity of highways, fall rapidly within the first 100 meters, and return to background levels by about 500 meters[22-24].

Children living in close proximity to highways are exposed to higher concentrations of vehicle-related carcinogenic pollutants. A study of 700 cases of acute lymphoblastic leukaemia showed that children living within 500 meters of high-speed highways were twice as likely to develop the disease compared to unexposed children[25]. A recent nationwide cohort study in Switzerland investigated whether cancer risk is associated with proximity of residence to highways[26]. This study, which included all children aged <16 years from Swiss national censuses in 1990 and 2000, demonstrated an increased risk of leukaemia among children living in the immediate proximity (<100 meters) of highways. This association was strongest in children under five years of age, who had double the risk of developing leukaemia[26]. Similar results were observed for acute lymphoblastic leukaemia; however, no increase in risk was observed in older children, or for lymphoma, central nervous system tumours or other cancers. Importantly, these results did not change significantly after adjustment for confounders such as socio-economic status[26]. These studies suggest that young children living close to highways are at increased risk of developing leukaemia. The carcinogenic effects of vehicle emissions are one plausible explanation for this association.

Currently, Cancer Council Australia recommends that workers and workplaces employ a combination of control measures to minimise exposure to diesel engine exhaust, including using cleaner fuels such as ultra-low sulphur and other low-emission diesel fuels[27]. In Australia, the implementation of emission standards for on-road vehicles lags a few years behind the US and Europe, which are leading the implementation of diesel engine emission standards[28]. In addition, there is no national occupational exposure limit in Australia for diesel engine exhaust, except for a guideline provided by the Australian Institute of Occupational Hygienists[8], which was established in 2007 before dose-response relationships were established between diesel engine exhaust and lung cancer. Occupational exposure limits for diesel exhaust are still absent in most countries. Importantly however, the lack of emission standards may contribute to higher exposure prevalence and exposure levels among Australian workers when compared with other countries.

As such, Cancer Council Australia strongly supports the work of the Australian Government Ministerial Forum on Vehicle Emissions, which is coordinating a whole-of-government approach to reducing motor vehicle exhaust emissions that harm human health. The Forum's focus on improving fuel quality will help reduce the level of harmful emissions, and improve air quality and health outcomes (including cancer) in the Australian population.

In this submission, we have highlighted the significant impact that vehicle exhaust emissions have on the Australian community:

- Exhaust from petrol engines contributes to air pollution, which is a proven cause of lung cancer. There is strong evidence, short of unequivocal proof, that emissions from petrol engines cause lung cancer.

- Approximately 14% of the Australian workforce (1.2 million people) are exposed to diesel engine exhaust, which is a known carcinogen, with 1.8% (160,000 people) exposed at high levels.
- Diesel engine exhaust is the second most common carcinogen that workers are exposed to, behind solar UV radiation, and contains a mixture of gases and soot, also known as particular matter. Regular exposure to high levels of soot, over a long period of time, increases the risk of developing lung cancer, and possibly bladder cancer.
- Maternal and paternal occupational exposures to diesel engine exhaust before a child's birth may increase the risk of childhood brain tumours, possibly due to polycyclic aromatic hydrocarbon exposure.
- Long-term exposure to benzene, which is a known carcinogen, in petrol engine exhaust, increases the risk of leukaemia in occupationally exposed adults, as well as in young children living close to highways, main roads or petrol filling stations.

In the Discussion Paper, a summary of pollutants of concern and their health impacts is provided (Section 1.1, Table 2), as is an overview of common fuel components, additives and by-products (Section 1.3). Cancer Council Australia suggests that these sections could be expanded to include a more detailed discussion of the cancer-related risks of motor vehicle emissions, particularly with regard to the impact of diesel engine exhaust and benzene in petrol engine exhaust.

Based on the evidence outlined above, Cancer Council Australia supports the adoption of policy alternative D, which proposes the lowest polycyclic aromatic hydrocarbon limit in diesel fuel of all alternatives. Given the known health harms of benzene in petrol engine exhaust, Cancer Council Australia would also support the development of a sixth policy alternative, proposing a new fuel standard for petrol with a reduced benzene limit.

With regard to the estimates of health costs and benefits that will be used to inform the cost –benefit analysis for each of the proposed policy alternatives, Cancer Council Australia believes that the impact on cancer-specific outcomes will need to be considered in the integrated emissions, air quality and health risk model. In particular, the cancer risk of diesel engine exhaust in Australian workers, and in the community more broadly, as well as the risk of leukaemia from petrol engine exhaust in these groups, will need to be built into the model.

Cancer Council Australia looks forward to providing further input into the Ministerial Forum's assessment of policy alternatives for changing the fuel standards, and to the release of the revised standards, which once implemented, have the potential to reduce the burden of occupational and other cancers in the Australian population.

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