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Implication of Air pollution on health effects in Nepal: Lessons from global research

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The Environment Performance Index (EPI), which ranks 180 countries of the world based on high-priority nine environmental issues compromised of more than 20 indicators has ranked Nepal as 149th out of 180 countries on overall issues but 177th out of 180 on air quality issues just above India, China and Bangladesh in 2016[1]. The primary source of anthropogenic emission of various airborne pollutants is from the burning of fossil fuels during the combustion processes such as heating, power generation, motorised road traffic or ships and using solid fuel for domestic purposes[2]. Air pollution is a complex mixture of many components; chiefly particulate matters, sulphur dioxides, volatile organic compounds and oxides of nitrogen[3]. Although no safe limit concentration of air pollution has been identified below which air pollution has no effect on population health, different guidelines and target values have been proposed by various international organisations such as World Health Organisation (WHO)[4] and national governments -usually driven by scientific evidence on adverse health effects. In majority of the cases, the local or national level guidelines are less stringent compared to international guidelines, particularly driven by some cost, feasibility, and political commitment. In Nepal, emission control policies have begun after the Earth Summit 1992 with the introduction of "Vehicle emission Control in Kathmandu Valley 1993"[5] and the Constitution of Nepal 2015[6] has guaranteed people's right to live in clean and healthy environment [Article 35: 1 and 2], however, the past

experiences in Nepal suggests that the implementation is of a major concern.

The last decade, many big cities in Asia, particularly, New Delhi and Beijing have experienced repeated very heavy smog and consequently, the local authorities issued hazardous level warnings with an advisory to stay indoors including closure of schools for weeks. Recently, for example, New Delhi which experienced heavy smog piloted an odd-even scheme for two weeks to ease vehicular congestion on the roads and reduce emissions. Under that scheme, vehicles with even registration plate number ran on the road on even days only as was also the case for vehicles with odd numbers. Similarly, Beijing in 2008 had closed all the industries before the Beijing Olympic 2008 and controlled the flow of motorised vehicles and this saw dramatic reduction in the level of air pollution. This signals that air pollution has gradually become a priority public health issue for low and middle income countries (LMICs).

Kathmandu Valley is a rapidly urbanising city with population density of 4,415 people per Km² and a maximum 20,300 in the core city centres[7]. The number of motorised vehicles in Nepal has risen from 244 thousands in 1999/2000 to 1.3 million in 2012/2013 and although roughly half of all the vehicles operate in Kathmandu but the proportion of public transport is less than 3%[8]. Due to expansion of the cities and development infrastructures, the situation will be spreading to other parts of Nepal in near future.

Data from Kathmandu in 2007 at various thirteen locations suggest that the concentration of ambient air pollution particularly fine particulate matter (PM_{2.5}) at main roads and house veranda was over 13- and 4-folds higher than that recommended by WHO air quality guidelines of 25 µg/m³[4, 9]. The recent Environmental Performance Index 2016 has suggested increase in overall PM_{2.5} in Nepal over the last decade[1]. Similarly, household air pollution (HAP) was over 18-folds higher during our survey in 2007 than the WHO recommended guidelines [9]. The major reason for high ambient air pollution in Nepal is largely from traffic related with old and not properly maintained vehicles running in the major cities. Likewise, brick kilns and cement factories located in the suburban areas of major cities which release toxic pollutants in to the air contribute to high air pollution but further research is necessary to back this evidence. In addition, the recent Nepal Multiple Indicator Cluster Survey[10] reported that a two-third (74.7%) of the households in Nepal use solid fuels as a primary source of domestic energy to cook which contribute to higher level of household air pollution[10].

It is well recognised that exposure to air pollution is associated with an increase in ill health. According to the global burden of diseases (GBD) 2013, air pollution is the 5th leading risk factor with household air pollution (HAP) being the 7th and ambient air pollution (AAP) is the 12th, responsible for over 5.5 million premature deaths and 141.5 million years of disability adjusted life years[11]. In majority of the LMICs, HAP is well-recognised risk factors for cardiopulmonary diseases but evidence on health effects of AAP from major cities of LMICs is not well documented. The GBD Study 2013 estimated 3.1 million premature all-cause mortality could be attributed to AAP, of which 88% occurred in LMICs and majority of them in the WHO Western Pacific and South-East Asia regions.

Although majority of research on air pollution has concentrated on cardiorespiratory health outcomes in adult but recent research suggests that exposure to air pollution has been associated to have adverse effects from few weeks of conception to elderly and from hosts of adverse health outcomes such as low birth weight, infant mortality, acute lower respiratory infection, reduced lung growth and many more diseases during adulthood[12, 13]. A recent review from the United Kingdom reported 40,000 premature deaths were attributed to exposure to air pollution despite of air pollution levels in many UK cities being within the WHO air quality guidelines at majority of the time[14].

Despite these observations, there is no research that has studied the health effects associated with ambient air pollution in major Nepalese cities including Kathmandu. Recent outpatient data from the department of health (DoH) services in Nepal show that respiratory diseases are the top most reason

for outpatients' consultations in 2013-2014[15] with both upper and lower respiratory tract infections being within the top 4 and chronic obstructive pulmonary disease being the topmost cause of mortality among inpatients[16]. GBD estimated deaths due to COPD have increased by 43% in 2013 compared to 2000 and now is the 2nd leading cause of death in 2013 (from 7th in 2000). Although prevalence of cardiovascular diseases is quite high in Nepal but so far there is no study that has studied the contribution of air pollution to it. Fine particulate matter are likely to pass into the systemic circulation and may affect the blood vessels by enhancing coagulation leading to blood clots, causing inflammation and also making the fatty deposits in the arteries less stable that might lead to number of cardiovascular outcomes such as hypertension, atherosclerosis, arrhythmias, myocardial ischemia, heart attacks, heart failure, and strokes.

As air pollution affects everybody and individual activities are likely to play a major role in combating air pollution problems, it is, therefore, essential that whole community from individuals to government must act urgently to protect the health and wellbeing. It is also essential that government must empower local bodies and encourage academic institutions with expertise in the matter to educate the society, health professionals and public at large by designing effective communication strategy. In countries like Nepal, government should also make their implementation and monitoring team more effective to make sure the policy and laws are not violated and polluters are made to pay for the damage to human health and the environment. One of the major concerns in countries like Nepal is that there is no reliable public transports which need to be strengthened and alternative mode of transport such as cycling for short routes must be encouraged by creating safe cycling routes. It is also essential the government also promote long term monitoring of air pollution and academic institution should be encouraged to study the health effects so that more effective policy can be formulated to reduce the pollution. Government should also protect the most vulnerable such as elderly and children who are more likely to be affected such as schools to be opened in less polluted environment and school area should limit the flow of vehicles.

As we have now moved on to the new development agenda, the Sustainable Development Goals (SDG) which includes several ambitious targets to reduce air pollution related death by 2030[17]. Being a signatory country of the Sustainable Development Agenda, Nepal should work with all stakeholders to address this issue. The Nepal Health Research Council[18] and recent National Health Policy of Nepal (2014) [16] have included 'air pollution' as a priority research/public health agenda that is guaranteed by the Constitution. There is an urgent need to organise the future

policies and actions to ensure the commitments to reduce air pollution.

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