Superior Health Council

ENVIRONMENTAL AND SUSTAINABILITY ASPECTS OF THE COVID-19 PANDEMIC

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Superior Health Council

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Environmental and sustainability aspects of the COVID-19 pandemic

In this scientific advisory report, which offers guidance to public health policy-makers, the Superior Health Council of Belgium advocates an interdisciplinary human ecological approach to the COVID-19 pandemic.

This report aims at providing policy-makers with recommendations on health and environmental prevention strategies to reach a more integrated and rational reply to future virus outbreaks.

This version was validated by the Board on
7 July 2021

EXECUTIVE SUMMARY

The ongoing COVID-19 (Coronavirus disease 2019) pandemic is a once in a lifetime experience for the contemporary generations. During the first months of the worldwide epidemic most scientific attention was given to the medical aspects, in particular to epidemiology and virology. Gradually the reciprocal impact of the environmental quality on the transmission of the virus and the effects of the lockdown to control the transmission become documented. It becomes clear that the disease and the way countries limit its transmission, also have environmental aspects and impacts on health and sustainability.

Sustainable development includes aspects related to economy, society, and environment. The lockdown, which was installed in many countries to limit social contacts and consequently the spread of the disease, has a strong effect on the economy from local to global: in many sectors people lose their jobs, companies struggle with a decreasing profitability, and countries do not know yet how to deal with the financial craters in their budget as a consequence of the ongoing mitigation measures.

In fact, a systematic 3 R (Reasons-Responses-Recommendations) study reported mainly negative effects on 13 out of the 17 United Nations (UN) Sustainable Development Goals (SDGs).

Physical distancing, considered the most efficient way for a population to control the spread of the SARS-CoV-2 virus (Severe Acute Respiratory Syndrome Coronavirus 2), causes psycho-social problems among elderly, young people and other groups in society. It is associated with an increase in security problems and profoundly disturbs tourism and migration.

At the environmental side the number and the quality of the data on aspects affected either directly by COVID-19 or indirectly through the measures to limit the infection incidence, increase fast. Of notice in the recent literature are:

- Studies show that the seasonal transmission of COVID-19 depends on temperature and humidity. For example, the virus exists during winter, but as soon as the temperature rises there is less transmission. A 1 °C rise in temperature would reduce transmission by 13 %.

On the other hand, there would be an inverse correlation between the doubling time of infection and humidity. However, these relationships are only partially cleared out.

- COVID-19 first infects the upper respiratory tract causing dry cough and fever, and spreads afterwards progressively to the lower respiratory tract and other organs. Therefore interaction with pollutants such as $PM_{2.5}$ (particulate matter < 2.5µm), NOx, ozone, and SO_2 in susceptible groups is not surprising. A minor increase of 1 microgram in $PM_{2.5}$ concentration is linked with an increase in time on a ventilator for a hospitalized patient and possibly an 8-11 % increase of the COVID-19 death rate.
- Population density: a correlation study in 5 states in India's first waves showed that the coronavirus spread depends on the spatial distribution of the population density in 3 of these states.
- At the same time lockdown measures resulted in drastic improvements in selected air pollutants and water quality in many cities worldwide as a result of a reduction in traffic and industrial activities. This equally resulted in lower emissions of greenhouse gasses.
- The spread of the virus drives measures to use masks, gloves, hand sanitizer, and other protection materials. In particular the home use of these items resulted in a massive amount of (semi-)medical waste in the environment, while at the same time specific measures to deal with this problem were absent.

These data call to include an interdisciplinary, human ecological approach in the COVID-19 and related prevention and management strategies of the spread of the pandemic.

Keywords and MeSH *descriptor terms*[1]

MeSH terms*	**Keywords**	***Sleutelwoorden***	***Mots clés***	***Schlüsselwörter***
'COVID-19'	COVID-19	*COVID-19*	*COVID-19*	*COVID-19*
'pandemics'	pandemic	*pandemie*	*pandémie*	*Pandemie*
'environment'	environment	*leefmilieu*	*environnement*	*Umwelt*
-	sustainability	*duurzaamheid*	*durabilité*	*Nachhaltigkeit*
'sustainable development'	sustainable development	*duurzame ontwikkeling*	*développement durable*	*nachhaltige Entwicklung*
'climate'	climate	*klimaat*	*climat*	*Klima*
'air pollution'	air pollution	*luchtverontreiniging*	*pollution de l'air*	*Luftverschmutzung*
-	waste	*afval*	*déchets*	*Abfall*
'water pollution'	water pollution	*waterverontreiniging*	*pollution aquatique*	*Wasserverschmutzung*
'incidence'	incidence	*incidentie*	*incidence*	*Inzidenz*
-	mitigation measures	*mitigatiemaatregelen*		*Minderungsmaßnahmen*

MeSH (Medical Subject Headings) is the NLM (National Library of Medicine) controlled vocabulary thesaurus used for indexing articles for PubMed http://www.ncbi.nlm.nih.gov/mesh.

[1] The Council wishes to clarify that the MeSH terms and keywords are used for referencing purposes as well as to provide an easy definition of the scope of the advisory report. For more information, see the section entitled "methodology".

CONTENTS

ABBREVIATIONS

ACE2	Angiotensin-converting enzyme 2
CAMS	Copernicus Atmosphere Monitoring Service
CDC	US Centers for Disease Control and Prevention
CI	confidence interval
CO	carbon monoxide
COPD	Chronic Obstructive Pulmonary Disease
Covid-19	Coronavirus disease 2019
ELCR	excess lifetime cancer risk
ENVI	Committee on the Environment, Public Health and Food Safety
GDP	Gross Domestic Product
ICU	intensive care unit
NO_2	nitrogen dioxide
NRMA	*niet-risicohoudend medisch afval* – non-hazardous medical waste
PAH	polycyclic aromatic hydrocarbon
$PM_{2.5}$	particulate matter < 2.5µm
PM_{10}	particulate matter < 10µm
RMA	*risicohoudend medisch afval* – hazardous medical waste
SARS-CoV-2	Severe acute respiratory syndrome Coronavirus 2
SD	sustainable development
SDGs	Sustainable Development Goals
SHC	Superior Health Council
SO_2	sulfur dioxide
UN	United Nations
VOCs	volatile organic compounds
WHO	World Health Organization

I. INTRODUCTION AND ISSUES

COVID-19 is a highly infectious condition caused by SARS-CoV-2. This virus likely originated from China, from where it spread over South-East Asia and later on affected over 213 countries and regions worldwide (World Health Organization, 2020). Currently all continents are affected. On March 19th 2020 the World Health Organization (WHO) declared COVID-19 a pandemic.

During the first stages of the pandemic ample attention was given to the medical and the virological aspects of the infection, although many of these entailed direct or indirect environmental aspects. Transmission of the virus provides an example. Throughout the world COVID-19 shows five phases of transmission starting with phase 1, the *controlled transmission* stage: cases show travel history to infected countries but also cases of asymptomatic patients. Apart from the latter, infected people are isolated and treated in hospitals. Phase 2 is the *local transmission* phase, where the virus spreads in local surroundings through symptomatic and asymptomatic patients, often showing a travel history. Phase 3 is the *community transmission* phase, during which the disease spreads in the population. During this phase, social contacts become the most important factor for the spread of the disease. In phase 4, the disease *crosses borders* resulting in countrywide and intercountry transmission, where both the numbers of hospitalized patients and the number of deaths suddenly increase and the population situation turns into an epidemic. During the last phase, the virus *spreads international and inter-continental*, resulting in a pandemic.

During each of these phases the environmental conditions are key to understand the spread of the disease (Mohan et al., 2021; Nunez-Delgado, 2020). This report focusses on the environmental aspects and their impact on the mitigation of the pandemic. It takes off with an overview of the impact of classical meteorological parameters (temperature and humidity) on the SARS-CoV-2 virus and the COVID-19 associated illness. Thereafter the relationships between polluted air, the virus and the associated disease are discussed. Two aspects are dealt with:

a) the impact of polluted air on the spread of the disease, and
b) the impact of the lockdown on the quality of the air.

The report finally addresses impacts on water and waste. The consequences of these effects for a more sustainable, precautionary driven COVID-19 prevention strategy are discussed.

II. METHODOLOGICAL APPROACH

After analysing the project proposal, the Board of the Superior Health Council (SHC) and the standing working group of the SHC on chemical agents identified the necessary fields of expertise. An *ad hoc* working group was then set up which included experts in the various health and environmental issues. The experts of this working group provided a general and an ad hoc declaration of interests and the Committee on Deontology assessed the potential risk of conflicts of interest.

This report is based on a review of the recent (2019-2020) peer reviewed scientific literature, supported by a Google Scholar search, combining SARS and COVID-19 with the respective environmental effect terms (air, water, waste, and sustainability). Distinction was made between the direct effects on COVID-19, and the indirect effects resulting from e.g. the lockdown period. Early 2021, the combination “COVID-19” with “environment” resulted in thousands of hits for 2020. The combination of “COVID-19” and “Sustainable development” equally provided a similar order of references for 2020 in a series of reference retracing systems. Therefore a complete literature review was almost impossible. Most helpful were the special COVID-19 issues in a range of qualified journals. Ample use was made of the thematic issue on COVID-19 and the environment published by “Environment, Development and Sustainability” and the study “Air pollution and COVID-19” from the Committee on the Environment, Public Health and Food Safety (ENVI) committee of the European Parliament (Brunekreef et al., 2021).

The resulting review was combined with the comments of local experts.

Once the advisory report was endorsed by the *ad hoc* working group it was validated by the Board.

III. ELABORATION AND ARGUMENTATION

1. Climate

After the initial outbreak in China, COVID-19 showed a clear regional trend with higher incidence figures and severity of cases in Northern areas (Xu et al., 2020). Since these initial observations, a vast amount of literature (reviewed among others by Selcuk et al., 2020) analysed the relation between COVID-19 cases and weather parameters such as temperature, humidity, pressure, dew point, wind speed, and sunshine duration. Although the results vary, there exists a growing consensus that the number of cases drops as temperature rises. This means more cases during winter in the northern part of the northern hemisphere. Apart from temperature, also wind speed, air pressure, dew point, and humidity are negatively and statistically significantly correlated with COVID-19 cases (Selcuk et al., 2020; Awasthi et al., 2020). A literature review of the impact of temperature and humidity on the cases of COVID-19 shows that most research finds a negative relationship with temperature and humidity, but no correlation with rainfall (Selcuk, 2020). Doubling the incidence of the disease (doubling time) correlates positively with temperature and inversely with humidity (Oliveiros et al., 2020).

Analogous with flu infections, the literature speculates on seasonal transmission: COVID-19 will exist in winter at Northern latitudes, but as soon as the temperature rises there will be less transmission. The influenza virus is more stable in cold environments, and respiratory droplets, as containers of viruses, remain airborne longer in dry air. Cold and dry weather can also weaken host immunity and make the hosts more susceptible to the virus. High transmission in cold temperatures may also be explained by behavioural differences. For instance, people may spend more time indoors and have more chance of interacting with others. One estimated that a 1 °C rise in temperature reduces the transmission by 13 % (Carleton and Meng, 2020).

In spite of these data, the impact of seasonal variations has to be questioned.

Higher temperature and higher relative humidity potentially suppress the transmission of COVID-19. Specifically, an increase in temperature by 1 °C is associated with a reduction in the R-value of COVID-19 by 0.026 (95 % CI (confidence interval) (−0.0395 to −0.0125)) in China and by 0.020 (95 % CI (−0.0311 to −0.0096)) in the USA; an increase in relative humidity by 1 % is associated with a reduction in the R-value by 0.0076 (95 % CI (−0.0108 to −0.0045)) in China and by 0.0080 (95 % CI (−0.0150 to −0.0010)) in the USA. Therefore, it is concluded that the impact of temperature/relative humidity on the effective reproductive number alone is not strong enough to stop the pandemic (Wang et al., 2021).

Chong et al. (2021) studied the association between COVID-19 and environmental factors, however one needs to be aware that meteorologic conditions change as well as the measures to control the pandemic. In many of these studies, this was not controlled for. Thus despite temperature and relative humidity being significantly associated with the risk of COVID-19, one needs to be aware of the relatively limited contribution in comparison with the control measures. This is suggested by a recent study using the incidence data from 102 Chinese cities in the first epidemic period, in which the control measures have been taken into account. Once the control measures have been incorporated in the modelling analysis, the meteorological factors could only explain less than 1 % of the increase in variability of COVID-19 transmission, while control measures explained the variance for more than 40 % over all. This offers a basis to suggest that stringent control measures are necessary to control COVID-19 regardless of the meteorological conditions of an area.

2. Air pollution

2.1 Outdoor air quality

Air pollution is a complex mixture consisting of small particulate matter aerosols ($PM_{2.5}$, PM_{10}, i.e. respectively particulate matter < 2.5 µm and < 10 µm), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds (VOCs) derived from vehicular traffic, industry, and household emissions. The most important air pollutants in Belgium that affect health are NO_2, PM (which includes soot, nitrates, sulphates, carbon compounds, (heavy) metals, and biological particles), and ozone. Belgian scientists formed the basis of air pollution epidemiology after the infamous Meuse Valley air pollution disaster in 1930 (Nemery et al., 2001). The health effects of PM are well established now with long-term epidemiological studies demonstrated a causal link with morbidity and mortality from respiratory and cardiovascular disease, diabetes, and lung cancer. NO_2 and ozone are also associated with mortality and respiratory disease (Brunekreef et al., 2021).

In the early days of the pandemic, numerous affected countries have resorted to mitigation strategies involving some form of home isolation to curb the spread of the virus. These lockdowns have resulted in significant decreases in traffic-related air pollution, especially in the most highly polluted areas. Satellite and surface measurements measuring air pollution levels in 20 cities across the world have shown a reduction of about 28 tons of NO_2 (sum of 20 cities) and about 184 tons of CO (sum of 20 cities) during the study period (1 February to 11 May 2019 and the corresponding period in 2020). $PM_{2.5}$, PM_{10}, and NO_2 were reduced by about 37 µg/m^3, 62 µg/m^3, and 145 µg/m^3 respectively (Sannigrahi et al., 2021).

However, assessing the potential impact of air pollution on COVID-19 outcomes is challenging given the fact that the nature of air pollutants changed during the SARS-CoV-2 pandemic. Emissions from industry and traffic decreased in many places, whereas some countries adopted the unproven and ineffective policy of outdoor spraying with disinfectants. This practice may be noxious and causes eye and skin irritation. (WHO, 2020b)

2.1.1 Direct effects on COVID-19

Air pollutants are not only associated with acute respiratory illnesses but also with a wide range of chronic diseases like cardiovascular diseases, diabetes, cancers, and chronic liver and kidney diseases, most of which overlap with risk factors for severe COVID-19.

SARS-CoV-2 first infects the upper respiratory tract causing dry cough and fever. In some patients infection of the gastrointestinal tract causes nausea and diarrhoea. The infection may progress to the lower respiratory tract causing bronchitis and pneumonia. Cardiovascular effects are also frequently observed. This sequence of symptoms is equally characteristic for the exposure to high concentrations of air pollutants. Long-term exposure to pollutants such as SO_2 and fine particulate matter ($PM_{2.5}$) contributes to cardiovascular disease, reduces lung function, causes respiratory illness (including asthma), and thrombosis. Exposure to air pollutants may induce oxidative stress and free radicals, which in turn may damage the respiratory system, reducing the resistance to infections. These are reasons why a relation between air pollution and COVID-19 has been investigated (Fattorine and Regoli, 2020; Brunekreef et al., 2021).

Besides the impact of air pollution on respiratory diseases like COPD (Chronic Obstructive Pulmonary Disease) and asthma, air pollution has also been shown to promote respiratory viral infections (Domingo et al., 2020). The commonly accepted modes of viral transmission include transmission via larger droplets (which fall close to where they are expired). Initially the focus was on the transmission of SARS-CoV-2 via such larger droplets directly or indirectly by contact with infected surfaces (fomites). But on July 9th 2020, the WHO acknowledged airborne transmission via aerosols as a significant SARS-CoV-2 transmission route (WHO, 2020a).

Air pollution is emitted by a range of natural and anthropogenic sources ranging from traffic, over open fires, heating, to industrial pollution.

Among the range of possible interferences with COVID-19, the effects of exposure to PM and nitrogen oxides are most extensively documented. This report focusses on PM and in particular $PM_{2.5}$ and NO_2, which are significant pollutants in Belgium.

2.1.1.1 Particulate matter

Particulate matter (PM) is emitted by a range of natural and anthropogenic sources ranging from domestic heating, over traffic, to industrial pollution. PM includes nitrates, sulphates, carbon compounds, (heavy) metals, and biological particles.

In 2020 several early observations (often not yet peer reviewed) suggested significant associations between ambient concentrations of $PM_{2.5}$ and PM_{10} and COVID-19 across the most affected countries: China, Italy, India, and USA (for an overview see Copat et al., 2020; Brunekreef et al., 2021). Such association seemed logical since air pollution is known to cause many of the underlying illnesses that have proven to be a risk factor for COVID-19. In addition, it is known that air pollution can increase respiratory tract infections from other pathogens (possibly by reducing peoples immune response) and it is therefore likely that this is also the case for SARS-CoV-2. More specifically, prolonged exposure to air pollution increases the expression of ACE2 (Angiotensin-converting enzyme 2) which is the target of the SARS-CoV-2 virus and may thus lead to a more severe infection.

In addition to making people more susceptible to respiratory infection (especially children, elderly and COPD patients), it is possible that air pollution particles (aerosols) play a role in the transport of viruses through the air. This is unlikely in outdoor conditions but probably very relevant in indoor settings (see discussion in paragraph on indoor air pollution).

The first evidence on the temporal association between air pollution and COVID-19 was reported in China (Zhu et al., 2020). They observed that the effect of $PM_{2.5}$ on daily confirmed cases exceeded that of PM_{10}. In particular they found that a 10 µg/m^3 increase in $PM_{2.5}$ and PM_{10} was associated with respectively a 2.24 % and 1.76 % increase of the daily counts of affirmed cases.

Also in India a significant positive correlation was reported between $PM_{2.5}$ pollution in urban areas and the reported COVID-19 cases and resulting deaths (Sahu et al., 2020).

An econometric analysis of the relationships between air pollution and COVID-19, using data from 355 relatively small Dutch municipalities, provides evidence that an increase in $PM_{2.5}$ concentrations of 1 µg/m^3 is associated with an increase between 9.4 and 15.1 cases and between 2.2 and 3.6 in deaths (Cole et al., 2020).

Over all, these studies highlight the role of PM as a trigger and carrier of COVID-19. Hence, SARS-CoV-2 is not only carried by larger respiratory droplets from sneezing and coughing but also by smaller airborne particles emitted when speaking or singing. In addition, concentrations of virus-laden aerosol PM_{10} samples below 0.8 copies/m^3 have been identified, but is seems unlikely that these low concentrations do represent a major vector of transmission for SARS-CoV-2 in outdoor settings (Maleki et al., 2021).

An analysis of COVID-19 deaths and the air quality in nine polluted Asian cities showed a strong relationship between air pollution and increased reported deaths related to COVID-19. The continuous response to high concentrations of pollutants likely impacted the immune system of the people who died. Short-term exposure to $PM_{2.5}$ could act on the balance of inflammatory M1 and anti-inflammatory M2 macrophage polarizations, which might be involved in air pollution-induced immune disorders and diseases. In turn, exposure to particulate matter or ozone might activate cellular signalling networks including membrane receptors, intracellular kinases and phosphatases, as well as transcription factors that regulate inflammatory responses. The hypothesis that severe COVID-19 cases might result from higher tissue levels of ACE2, increased infection, and ultimately greater viral load is being actively investigated. Others have proposed that SARS-CoV-2 interaction with ACE2 leads to decreased ACE2 surface expression and impaired cardiopulmonary protection (Brandt and Mersha, 2021).

This is further supported by the finding that the mortality correlates better with $PM_{2.5}$ than with PM_{10} (Gupta, 2020).

Based on most partial and preliminary data also the World Economic Forum (2020) reported that an increase in particulate matter (PM) of 1 mg/m^3 was associated with an increase in COVID-19 incidence, hospital admissions and deaths.

Also the impactful COVID-19 outbreak in Italy was associated with air pollution concentrations. Northern Italy, where most of the cases and deaths were recorded at the beginning of the pandemic in Europe (March-April, 2020), has been constantly exposed for many years to high levels of chronic air pollution. Long-term air quality data significantly correlated with COVID-19 cases in up to 71 Italian provinces. This suggests that chronic exposure to air pollutants provides a favourable context for the virus (Fattoni and Regoli, 2020) although the mechanism(s) driving this phenomenon remains unclear.

A USA-wide study from the ‘Center for Systems Science and Engineering Coronavirus Resource Center’ of the John Hopkins University concluded that a 1 µg/m^3 increase in $PM_{2.5}$ concentrations is associated with an 11 % increase in COVID-19 death rate (Wu et al., 2020). These results were however not replicated in a later study using similar data and design but using better statistical techniques (Liang et al. 2020).

Overall these studies highlight the possible role of PM as a carrier and trigger of COVID-19 and how measures targeting sustainable growth in a reasonably clean environment could have a positive impact on the prevention of health effects, reducing mortality, and the burden on health care systems.

Unfortunately the epidemiological methods that have successfully demonstrated the ill effects of air pollution require that people in large cohorts are followed individually for many years or decades. Such a long-term study to determine the exact magnitude of COVID-19 on any health endpoint is not yet possible given the recent start of the outbreak. Another type of air pollution study looks at the correlation between day to day variations in air pollution and variations in mortality. Efforts to do this in 2020 were hampered by the simultaneous effects of the lockdown measures on both air pollution and the epidemic, which can easily lead to spurious correlations which may not be causal (Brunekreef et al., 2021).

Most available studies today have used (out of necessity) an ecological or cross-sectional design which may lead to unreliable results depending on misclassification (e.g. were all infected people diagnosed correctly) and aggregation level (e.g. Brunekreef et al. (2021) refer to one study from Hubei province that found positive, no or negative association depending on the geographical aggregation level). Data on confounders, i.e. personal characteristics (age, income, etc.) that can correlate both with the severity of COVID-19 and air pollution, are not yet taken into account.

In general, there is a high association of COVID-19 infections with air pollution in cities measured during days exceeding the PM_{10} limits or ozone limits during previous years (Coccia, 2020; Barcelo, 2020).

Of particular interest is the impact of air pollution on the emergence and on the worsening of pulmonary disease. For patients with a risk of emerging respiratory infections, for developing reduced pulmonary function, and/or aggravation of existing pulmonary disease (asthma, cystic fibrosis, COPD), exposure to polluted air by PM is a risk factor. COVID-19 patients suffer long-term consequences for their respiratory and cardiovascular health. These weaknesses will likely make them more vulnerable for the effects of air pollution in the future (e.g. when lockdowns are lifted). It was recently shown by Belgian researchers that intensive care unit (ICU) patients were kept on ventilators longer when preceding air pollution was higher (De Weerdt et al., 2020).

2.1.1.2 Nitrogen dioxide (NO_2)

Next to particulate matter, NO_2 deserves attention. Apart from its natural occurrence, NO_2 is emitted by transport and fuel combustion.

NO_2 mainly affects the respiratory system. An increase of the (indoor and outdoor) concentrations may significantly increase the risk of respiratory tract infections, especially in children. Hence, viral infection becomes more common after NO_2-exposure. NO_2-exposure also increases the risk for other lung problems such as asthma, asthma with eczema, and COPD.

The first reports on an association between ambient concentrations of NO_2 and COVID-19 across Europe, China and the USA were complemented by studies which did not find this relationship or even reported a negative association (Copat et al., 2020).

Zhu et al. (2020) observed in China that a 10 µg/m^3 increase in NO_2 is associated with a 6.5 % increase in the daily counts of COVID-19. Long-term exposure to NO_2 may be a potential contributor to the mortality caused by COVID-19. This statement is based on high COVID-19 mortality rates in locations with high NO_2-concentrations in Italy and Spain (Copat et al., 2020).

During the lockdown, European cities witnessed a decrease in traffic from 65-85 %. This led to a reduction of traffic-associated pollutants, including NO_2.

NO_2-concentrations dropped in northern Italy, Spain and the UK (Ficetola and Rubolini, 2020). The morning rush hour induced NO_2-concentrations at traffic hot points were reduced by approximately 50 % (Tanzer-Gruener et al., 2020). By April 2020, NO_2-concentrations were significantly reduced across Europe. This reduction was independent of the meteorological conditions (EEA, 2020; Celik and Gul, 2020).

Although the scientific reports are not unequivocal, it can be concluded, based on increasing evidence, that exposure to NO_2 is likely one of the important environmental triggers for the occurrence and fatalities caused by COVID-19.

2.1.2 Lockdown effects

The lockdown in many countries worldwide has resulted in unpreceded reductions in economic activity and traffic, which affected the main air pollution sources: home heating, electricity generation industry, and most importantly mobility (HGR, 2011). This resulted in significant improvements in the (urban) air quality. NO_2-concentrations dropped in northern Italy, Spain and the UK (Ficetola and Rubolini, 2020). In the Indian capital Delhi the reduction of PM_{10} and $PM_{2.5}$ was 60 % and 39 % respectively, as a result of the local lockdown (Mohapatra et al., 2020). In Belgium (ISSeP, 2020) lockdown periods took place simultaneously with:

- particular weather conditions which did not favour the dispersion of the pollutants;
- activities by agriculture, including the use of fertilizers spreading and emitting ammonia and secondary PM precursors;
- an episode of Sahara dust.

During the complete lockdown in New York (USA) from March 22-31, 2020, CO levels (1.7 to 0.22 ppm), NO_x concentrations (25 to 12 ppb), SO_2 (0.95 to 0.25 ppb) and $PM_{2.5}$ (10.3 to 3.5 µg/m^3)

decreased. However, ozone (O_3) concentrations increased from 0.02 to 0.03 ppb due to lower local NO_2-immissions (Shehzad et al, 2021). In Pittsburgh, Pennsylvania, USA, the COVID-19 related closures resulted in an overall decrease of $PM_{2.5}$ concentrations by approximately 3 µg/m^3. The morning rush-hour-induced CO and NO_2 concentrations at traffic hot points were reduced by approximately 50 % (Tanzer-Gruener et al., 2020).

In 2020, Rajpur (India) coped with 4 countrywide lockdowns. During these periods the average $PM_{2.5}$ concentrations were reduced by more than 90 % (from 136 µg/m^3 during normal pre-COVID-19 days to 11 µg/m^3 during lockdown 1). Black carbon mass concentrations dropped from 9 µg/m^3 to 2 µg/m^3 during the first two lockdown periods. Average polycyclic aromatic hydrocarbon (PAH) concentrations reduced from 136 ng/m^3 to 15 ng/m^3 during the first lockdown period. Calculated health hazard assessments and excess lifetime cancer risk (ELCR) improved accordingly (Ambade et al., 2020).

Similar results on improved air quality during lockdown periods have been reported worldwide (for a review see Celik et al., 2020).

The European Environment Agency (2020) assessed the impact of the lockdown during spring 2020, focusing on NO_2 and $PM_{10.}$ The assessment was based on measured data and took into account changes due to meteorological variability, and model based estimates by the Copernicus Atmosphere Monitoring Service (CAMS). Emphasis was given to the limitations and uncertainties of the assessment due to meteorological, seasonal, land use (urban, rural), and landscape parameters.

In Brussels the nitrogen exposure varied over time. The mean average weekly concentration of NO_x dropped during the first and second COVID-19 wave, but reached 44 µg/m^3 by early March 2021.

Worldwide, important variations in the air quality improvement exist between countries (from 2 % in Sweden to 89 % in Senegal) and the type of lockdown (from 13 % during the full lockdown in the UK, to 2 % in Sweden during a partial lockdown) (Talukdar et al., 2020). In the early days of the pandemic, numerous affected countries have resorted to mitigation strategies involving some form of home isolation to curb the spread of the virus. These lockdowns have resulted in significant decreases in traffic-related air pollution, especially in the most highly polluted areas. Satellite and surface measurements measuring air pollution levels in 20 cities across the world have shown that ~ 28 tons of NO_2 (sum of 20 cities) and ~ 184 tons of CO (sum of 20 cities) have been reduced during 1 February to 11 May 2019 and the corresponding period in 2020. $PM_{2.5}$, PM_{10}, and NO_2 are reduced by ~37 µg/m^3, 62 µg/m^3, and 145 µg/m^3, respectively.

No clear linear relationship exists between air pollution in a single country and the measures taken, because of the complexity of the air pollution chemistry. In Belgium for example, high PM concentrations were reported in the last week of March 2020, two weeks into the lockdown, because of higher emissions from wood burning combined with meteorological conditions that facilitated the formation of secondary aerosols. Prior to the 13 March lockdown, air quality was relatively good because of rainy weather and higher wind speeds (VMM, 2020). A full analysis in 2021 of 2020 air pollution concentrations will be necessary to determine the scale of emission reductions and the effect on concentrations. It is expected that on average NO_2-concentrations in Belgium for the entire year of 2020 will be between 20 and 30 % lower (which implies higher ozone concentrations), and that there will be little or no effect for PM. Higher values are expected to remain in some hotspots, which indicates the scale of measures needed to clean the air post-COVID-19.

Another indirect beneficial health effect of the lockdown is that less people than what could be statistically expected were injured or killed in traffic. 6 % fewer were killed during the first trimester of 2020 (of which only two weeks were in complete lockdown) and 14 % fewer injuries were registered. Data for the full year 2020 are not available yet. Accidents that did happen during the lockdown proved to be twice as deadly indicating driving at high speed by those that did drive (Vias, 2020).

Indirect health benefits can also be expected from a reduction in traffic noise (especially from passenger aircraft in the vicinity of airport during the day and from roads). In the beginning of the spring 2020 lockdown an average reduction of 10 to 12 decibel was seen in a lot of parts of Flanders with smaller reductions near highways; -3dB was reported from the Netherlands. Different effects are expected for the curfew period during the second semi-lockdown with more effects at night (and hence potentially more health benefits) (VRT, 2020).

Also on tropospheric ozone concentrations the lockdown has a complex impact. A complex balance exists between the ozone formation and its destruction. Despite significantly less traffic, enough NO_2 and volatile organic compounds remained in the air to give rise to ozone. On the other hand the lower concentrations of NO at the measurement points near traffic, resulted in a lower rate of ozone degradation. The net result is an increase in O_3-concentrations (Bruxelles Environnement, 2020).

In general, there is a high association of COVID-19 infections with air pollution in cities measured during days exceeding the PM_{10} limits or ozone during previous years (Coccia, 2020; Barcelo, 2020).

2.2 Indoor air quality

As indoor air entails the same pollutants as the outdoor air, often in higher concentrations, it is obvious that analysing the literature leads to similar health effects. Relevant environmental conditions include the time spent in the rooms, the ventilation rate, temperature and humidity, and the number of occupants (Morawska and Cao, 2020; Morawska et al., 2020). Less publications on this subject exist as compared to the number of articles on COVID-19 and outdoor air quality. However, of particular interest are the proceedings of a webinar on COVID-19: “The issue of airborne transmission and how to minimize risks indoors” (June 19th 2020, Niel, Belgium (eu.reca, 2020)).

Mouth and nose are the sources of spreading virus contaminated expiratory droplets. Larger droplets can be transmitted by close contact (< 1.5 m) or by touching the places of deposition. Smaller droplets behave like aerosols in the room and may remain in suspension up to 3 hours after emission. The highest concentrations have been found during speaking, singing and coughing (Buonano et al. 2020a,b; Morawska et al., 2009). This means that close contact is not the only transmission route of the virus; airborne transmission is it as well. Sedentary breathing may be also a significant source of virus emission. The viral load of respiratory particles varies significantly throughout the phases of the disease; the highest viral load was found in persons recently infected but not yet showing symptoms (Miller et al., 2020). The SARS-CoV-2 breath emission rate in the air was found to be high (up to 10^5 viruses per minute) during the earlier stages of COVID-19. This shows that airborne transmission should also be considered as a transmission route of the virus.

The infection risk of airborne emissions may be estimated in a quantitative way using models taking into account the parameters known to influence the risk.

These findings equally explain why sufficient and effective ventilation of rooms is the prevailing strategy in a Belgian climate to prevent infections. In case sufficient ventilation cannot be realised, cleaning and disinfection of the air will limit the contact with the virus. Only if natural ventilation is limited or impossible, technical solutions to limit the contact with the virus (UV-light, air cleaners, etc.) contribute to the prevention of the infection. In this context, the SHC refers to its previous reports, including the one on ventilation (HGR, 2021).

3. Waste

The extensive social impact of COVID-19 and the protection measures and the limitations in the commercial activities and mobility have affected the nature and the amounts of waste produced during and in the aftermath of the pandemic.

Two waste streams deserve particular attention:

a) Solid hospital waste:

The management of medical waste was a problem at the onset of the pandemic. Few properties of the virus were known and, probably more by intuition than founded on hard evidence, all material used for the treatment or diagnosis of patients was considered as dangerous (Hoseindzadeh et al., 2020; WHO 2014, 2020). The finding that the virus has extended survivability on many surfaces is indeed suggestive for a precautionary approach of the management of the waste (Wiktorczyk et al., 2021; Van Doremalen et al., 2020). Rather confusing and conflicting messages were distributed by for example the CDC (US Centers for Disease Control and Prevention), who stated that the waste from COVID-19 patients was not different from other patients, while the WHO advised people handling healthcare waste from COVID-19 patients to wear boots, aprons, long-sleeved gowns, thick gloves, masks and face shields. This is unnecessary if the waste is considered harmless.

As a consequence, the amount of medical waste considered to be of risk increased significantly. In Wuhan, the amount of waste considered at high-risk was in March 2020 about 5 times the volume compared to the pre-COVID-19 period, while the density of the waste (kg/m³) decreased from 120 to 67-85 because of the abundant use of the lightweight single-use personal protection equipment such as aprons, gloves, masks, etc. (Wei, 2021).

In Belgium, hospital waste from COVID-19 patients was initially considered as RMA (*risicohoudend medisch afval* – hazardous medical waste) in Flanders or as B2 in Wallonia and Brussels (medical waste with risk) requiring the collection in specific designated single-use polypropylene containers of 30 or 50 litre or in cardboard boxes with yellow plastic bag. In view of the foreseeable limited availability of this type of containers, the initial strategy was reviewed and part of the waste was considered either as NRMA (*niet-risicohoudend medisch afval* – non-hazardous medical waste) in Flanders or B1 in Wallonia and Brussels (medical waste without risk) provided the waste was kept at the site of the hospital for 72 hours. The strategy and all protocols were set up in collaboration with the Belgian sector federation of waste (Ska, 2020).

It has to be mentioned that the switch form risk to non-risk waste was primarily due to the limited availability of the containers and secondly by virological considerations. Furthermore, any decision was susceptible to the considerations of the department of hospital hygiene and frequently the precautionary principle fully applied characterising waste from COVID-19 patients as risk waste. Also, keeping waste compactors for three days can be difficult from a logistic point of view. In summary, there was some confusion typical for a crisis situation.

In many hospitals in Belgium, the point of view still is that waste from COVID-19 patients should be considered as RMA or B2. Preliminary results in one university hospital demonstrate the impact of this decision. During the first wave of COVID-19, a temporarily marked decrease of non-urgent postponed medical treatment from other “normal” patients as compared to the pre-COVID-19 period was noted. The decrease of the amount of risk waste (fewer non-COVID-19 patients) and the increase of risk waste because of the increasing number of COVID-19 patients acted as communicating vessels leaving the total amount of medical risk waste nearly constant.

During the second wave, the decrease in non-urgent treatments was less pronounced while the number of COVID-19 patients was higher than during the first wave. The consequence was that the amount of risk waste from the hospital increased significantly.

A second observation was that the amount of waste generated by treatment of COVID-19 patients expressed in kg weight/day/bed occupied by a COVID-19 patient, is about 3 to 5 times higher than from non-COVID-19 patients. This is explained by the abundant application of single-use personal protection materials such as gloves, aprons, etc.

Finally, it was found that the weight of the vessels containing risk waste from COVID-19 patients was significantly lower than the weight of the vessels containing risk waste from non-COVID-19 patients. This is again in line with the use of lightweight materials for personal protection. When put in waste containers, this represents evidently a lower weight per container. All these findings (Fraeyman, 2021) are compatible with the ongoing information from the literature (Wei, 2021).

b) Non-medical and household waste:

The lockdown and the stay-at-home policy and other preventive measures to counteract the spread of COVID-19, resulted in an increased production and consumption pattern of conventional household products and in products directly related to in-house protective measures (masks, gloves, thermometers, sanitizers, cleaning products). The panic buying wave at the beginning of the pandemic increased the consumption of food and its packaging, among them micro- and nanoplastics, and likely its presence in the environment (Jiang et al., 2020). The sudden lockdown and fear for the virus lead to more single-use products (Sarkodie and Owusu,2020). In particular the high amounts of mouth masks, which were mandatory as soon as they were available, offered a problem of potentially contaminated waste, for which the logistics were often insufficient or hardly available. It has been demonstrated that some types of mouth masks (e.g. Avrox) entail silver and titan dioxide components, although their toxicological impact is currently unclear (HGR, 2021).

All this had a significant impact on the management of household waste.

In spite of the fact that the total amount of household waste increased considerable, the fear of spreading the virus through the household waste seems minimal (De Maria et al., 2020). Although these findings require confirmation, apparently the management of household waste during the pandemic will not need particular treatment other than what is now custom for conventional household waste.

The conclusion is that the situation with respect to medical and potentially contaminated household waste in Belgium and beyond during the COVID-19 pandemic is complex. It is assumed that progressive insights in the key properties of the virus will lead to more coherent decisions. Some questions for further consideration remain. First, the focus on the SARS-CoV-2 virus will have to expand to the different mutated versions in particular the α (UK), the δ/κ (Indian) and the β (South African) variant. The fact that some of these mutants of the SARS-CoV-2 virus are more contagious than the virus active in the first wave is particularly troublesome (Leung et al., 2021). To our knowledge, no data on the impact of these mutants in (medical) waste are available. Second, the question whether COVID-19 waste has to be considered as risk or non-risk waste is not fully solved. Additional experimental data will be needed.

4. Water pollution

The COVID-19 lockdown not only reduces air pollution. The literature describes cases of COVID-19 measures affecting the water quality. The water quality in the Indian Ganges near holy cities improved during the lockdown because the number of pilgrims using the water decreased as a result of the limited mobility during the pandemic. Also the close down of factories located along the river bank added to an improved water quality (Mohaptra et al.,2020). A similar trend was reported for the Venice lagoon in Italy (Braga et al., 2020). Estimated turbidity values declined until levels similar to the values normally found in the lagoon areas around the city.

Using a remote sensing approach Das and Kaur (2020) showed that the complete lockdown had a beneficial impact on all six measured water quality parameters of the Buddha Nada river in Punjab (India). This points to an overall improvement in water quality and vegetation growth in the basin.

The presence of the virusses in this medium is an indicator for the scale of infection. Before, noroviruses, poliovirus and measles virus were detected in wastewater, providing fuel to the idea of Waste Water Based Epidemiology. The first data detecting SARS-CoV-2 in sewage were reported in The Netherlands (Medema et al.,2020), soon thereafter followed by Australia (Ahmed et al., 2020) and France (Wurtzer et al., 2020). Today detecting and measuring SARS-CoV-2 in untreated wastewater is widely accepted as an early indicator strategy for the presence of the viral problem for the population (Barceli,2020).

The increased use of broad spectrum antimicrobials for personal hygiene and environmental disinfection which enter into sewage water, might seriously hamper the interpretation of the data.

In many countries it is indicated to study the quality of the coastal water in relation to the COVID-19 measures influencing the number of coast visitors.

From a safety point of view, no conclusive evidence exists for infection through exposure to (waste)water. On the other hand, there is accumulating evidence to integrate SARS-CoV-2 in wastewater management, and shellfish and recreation water quality.

5. Sustainable development

The current sustainable development (SD) framework is converted into 17 SDGs (UN, 2020) and 169 targets. An exploratory data analysis combined with a 3 R (reasons, responses, recommendations) approach showed that COVID-19 affected most of these targets. Air pollution, the blue and green economy, wildlife, violence prevention, and the urgent global SD partnerships are most under pressure.

A common widespread interpretation of sustainable development is based on three pillars: society, economy and environment. COVID-19 affects each of these components and their interrelations.

a) Environment:

   Above the impact on the physical environmental compartments is discussed. This list of impacts is incomplete. Addressing for example climate changes, the loss of biodiversity, land use changes and the impact of demography are as significant as the discussed elements. As a result of the reduced human pressure on the ecosystems during the lockdown, air and surface water quality temporally improved. This impacted biodiversity and reduced the consumption of natural resources. It is however currently unclear whether and to which extent these improvements might be safeguarded post-COVID-19 to avoid the environmental benefits slipping away (Celin, 2020).

b) Economy:

Not only the number of COVID-19 cases and deaths, but even more the lockdown measures impacted the global economy. Many people lost or will lose their job, which causes financial insecurity. The gap between the “haves” and the “have-nots” widens. Specific consequences in Belgium for the “poor” entail:

- The increasing digitalization during and after the lockdown periods results in exclusion mechanisms.
- Social security was performant for those having access to social security, but less for people with limited job security.
- The poor will faster and easier decide to delay medical, including psychological care.
- Existing inequalities such as learning disabilities became more pronounced during the pandemic.
- Necessary precaution measures as ventilation are often more difficult to realize in sub-modal housing conditions. Economically disadvantaged people have less access to nature to cope with the lockdown effects (Van Hootegem, 2020).
- In 2020, most European countries faced a negative economic growth of 2-5 % of the Gross Domestic Product (GDP) as a result of declining export earnings and the largely closed tourism, cultural and entertainment sector. These figures exclude the effects of the 2nd wave of the pandemic during the last quarter of the year. At policy levels, measures were put in place to counteract the adverse effects and to stimulate the economy in particular in heavily affected sectors.

c) Social aspects:

The infection incidence is highest among the poor. Varying rates were observed among the gender categories and ethnic groups. Social activities in the population as a whole like weddings, funerals and entertainment accelerate the spread of the virus.

The heavy economic impact of the pandemic resulted in a wide scope of social effects, domestic conflicts, additional child abuse, and (help in) teaching the school curriculum. Physical distancing is often considered the most effective way to control the virus spread over a population. At the same time it causes psychosocial problems among different groups in society. Socially vulnerable groups live more frequently next to high traffic roads, near industrial zones, and in urbanized green-poor areas. Their houses are smaller, less ventilated, poorly isolated and often humid. They face energy poverty and are forced to save money on heating, water, electricity, healthy food, clothes, and medical care. In 2020, in Belgium, 195 000 citizens per month used the free food distribution. This coincides with a significant increase as compared with the previous years. The COVID-19 crisis also resulted in intra-familial violence. An increasing number of people searched for help on intra-familial violence and child abuse.

Next to these negative social consequences, one noticed as positive effects an altered awareness of time, much less dominated by the traditional work schedule and other appointments (Klatt et al., 2020). In its advice 9610 on “Covid and mental health” the Council analysed these effects more in detail (HGR, 2021).

IV. CONCLUSIONS AND RECOMMENDATIONS

A fast growing amount of evidence shows the intensifying effect of air pollution, in particular of $PM_{2.5}$ and NO_2, on the number of COVID-19 cases, the recovery and deaths. The COVID-19 prevalence should therefore be assessed in combination with air pollution. The picture is complex: on the one hand air pollution appears as a significant stimulating factor on COVID-19 infections, but is not explicitly addressed in the transmission and deaths. Major findings highlight a possible contribution of $PM_{2.5}$ and NO_2 in stimulating the COVID-19 spread and lethality. On the other hand the lockdown measures resulted in an improved air quality, for example in cities, no doubt with beneficial effects on the morbidity (risk) figures.

During the lockdown periods, a significant improvement of the (urban) air quality and a related improvement in the health impacts was noticed worldwide. Although the studies on air pollution and its impact on COVID-19 are still in an early phase and will be refined during the years to come, the current evidence is more than enough to motivate more effective air pollution abatement than we face today. Taken together the data in particular on particulate matter provide a basis to rethink the health effects of air quality after COVID-19 (Chieg and Kajino, 2020).

In a more comprehensive context, measures to bring down the emissions of greenhouse gasses will result in benefits for the transmission and hospital impacts of COVID-19 patients. The role of indoor air pollution remains undervalued. More attention should be given to the quality of indoor air starting with the removal of obvious sources of indoor air contamination as passive smoking and burn all-/woodstoves.

The complexity of the situation relates the discussion with the application of the precautionary principle. Precaution is applicable as an action strategy to prevent or limit serious threats for health and environment. Precaution aims at dealing with uncertainty in an alert, rational, and transparent way. It supposes international collaboration and transdisciplinary assessment of data (Eggermont, 2021). In this context the environmental data on Covid 19 should be an integral and necessary part in the evaluation of the effects and the action strategy to deal with the pandemic.

Less information is available on the impact on the surface water quality, but thus far, studies on selected places point to an improved water quality during the lockdown periods.

The environmental health links discussed above illustrate the importance of an interdisciplinary approach to understand the infection patterns and the distribution of COVID-19. Therefore the problem is related to the EU-supported “One Health” approach. This is an integrated concept which acknowledges that human health is closely linked to animal health, a healthy environment, food safety and security, and agricultural practices. “One Health” measures should be assessed in a context of what they contribute not only to human health directly, but also indirectly to the early prevention of zoonotic diseases and the spread of disease transmitting organisms. Currently “One Health” strongly focusses on zoonoses, but the approach should be widened towards a more holistic interpretation of the health-livelihoods relation (Lajaunie et al., 2020).

The COVID-19 pandemic offers lessons for waste management. More attention should be given to the COVID-19 related streams of medical and non-medical waste. This additional attention should be more than the distribution of topical flyers. The pandemic requires structural adjustments and accentuates the importance of transitioning from a linear to a circular economy.

The pandemic affects major elements of sustainable development. It is indicated evaluating the existing SD plans while bringing the COVID-19 effects into account. In particular the effect of the pandemic on the realization of the sustainability targets should be (re-)considered.

The lockdown, which was a major strategy in preventing the spread of the virus, has often attracted criticisms because of its far-reaching social impacts and aspects of overregulation. This analysis of the environmental health aspects also points to positive lockdown effects: the improvement of the air quality, in particular in cities, and likely mainly tourism related effects on a better water quality. The post-COVID-19 targets are returning back to “normal life” as soon as the virology parameters allow it. However one may consider keeping these advantages as much as possible while returning to “normality”.

This overview of the health and environment-related aspects is incomplete. Important issues as the impact on soil and the effects on wildlife, coupled with de- and afforestation for example remain out of focus. For most of these aspects more information allowing quantitative risk assessments is necessary.

Environmental health data should be a structural and integral part of the alert and response system countries have to develop to be prepared for future viral outbreaks. The parameters determining environmental health, and air pollution in particular, should be part of our surveillance systems to limit the infection incidence, the number of hospital admissions and deaths during future outbreaks.

COVID-19 is a recent phenomenon and the current literature is consequently characterized by major gaps and uncertainty. Both aspects may be alleviated by more targeted research. Among others, the following areas are in need of more data:

- The air pollution-COVID-19 infections/deaths incidence needs follow-up confirmation, more refined research (e.g. on the pollution and exposure type (acute versus long term)), and quantitative data which are applicable in risk assessment. Moreover, the results of statistic studies should be linked to and supported by work on biological mechanisms. Studies on the long-term environmental health effects on COVID-19 survivors are currently not available, but should be established during the years to come.
- The use of water quality as a Waste Based Epidemiology early monitoring indicator should be detailed and validated.
- The effects of COVID-19 on the seas and the oceans (overfishing, acidification) and their health impacts should be addressed.
- More data on both the hospital and household waste streams and their integration in the existing waste management approaches are imperative. The spread of microplastics from medical and household COVID-19 related waste is of concern.
- Sustainable Development plans at a range of policy levels should be revised bringing the COVID-19 experience on board.
- Effects on health, environment and economy are likely worse in many developing and emerging countries (in particular those with the fastest virus spread). The infection incidence is higher among the "socially" disadvantaged in the industrialized world. The effects on environmental health should be addressed in a structural way in the Belgian and European cooperation programs.
- Complementary review criteria to avoid uncontrolled data and “fake news” should be elaborated.

The outcome of this research should enable us with better and more rational replies to future outbreaks. In particular air quality should be considered an integrated part of the approach to sustainable development, health and prevention of epidemic spreads.

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VI. COMPOSITION OF THE WORKING GROUP

The composition of the Committee and that of the Board as well as the list of experts appointed by Royal Decree are available on the following website: About us.

All experts joined the working group ***in a private capacity***. Their general declarations of interests as well as those of the members of the Committee and the Board can be viewed on the SHC website (site: conflicts of interest).

The following experts were involved in drawing up and endorsing this advisory report. The working group was chaired by **Luc HENS**; the scientific secretary was Marleen VAN DEN BRANDE.

BOULAND Catherine	Environmental and occupational health	ULB
FRAEYMAN Norbert	Toxicology and environmental toxicology	UGent
GODDERIS Lode	Occupational and environmental medicine	KULeuven/IDEWE
HENS Luc	Human ecology	VITO
INT PANIS Luc	Mobility	VITO/UHasselt
KEUNE Hans	Ecosystem services, ecohealth, onehealth	UA/INBO/BBPF
ROMAIN Anne-Claude	Air pollution and air quality	ULiège
STEURBAUT Walter	Human exposure	UGent
STRANGER Marianne	Indoor air quality	VITO
VAES Bert	General medical practice	KULeuven

The following administrations and/or ministerial cabinets were heard:

NAVEZ Yseult	DVZ - PHE	FPS Health, Food Chain Safety and Environment
SCHUURMANS Chris		Federal Council for Sustainable Development

About the Superior Health Council (SHC)

The Superior Health Council is a federal advisory body. Its secretariat is provided by the Federal Public Service Health, Food Chain Safety and Environment. It was founded in 1849 and provides scientific advisory reports on public health issues to the Ministers of Public Health and the Environment, their administration, and a few agencies. These advisory reports are drawn up on request or on the SHC's own initiative. The SHC aims at giving guidance to political decision-makers on public health matters. It does this on the basis of the most recent scientific knowledge.

Apart from its 25-member internal secretariat, the Council draws upon a vast network of over 500 experts (university professors, staff members of scientific institutions, stakeholders in the field, etc.), 300 of whom are appointed experts of the Council by Royal Decree. These experts meet in multidisciplinary working groups in order to write the advisory reports.

As an official body, the Superior Health Council takes the view that it is of key importance to guarantee that the scientific advisory reports it issues are neutral and impartial. In order to do so, it has provided itself with a structure, rules and procedures with which these requirements can be met efficiently at each stage of the coming into being of the advisory reports. The key stages in the latter process are: 1) the preliminary analysis of the request, 2) the appointing of the experts within the working groups, 3) the implementation of the procedures for managing potential conflicts of interest (based on the declaration of interest, the analysis of possible conflicts of interest, and a Committee on Professional Conduct) as well as the final endorsement of the advisory reports by the Board (ultimate decision-making body of the SHC, which consists of 30 members from the pool of appointed experts). This coherent set of procedures aims at allowing the SHC to issue advisory reports that are based on the highest level of scientific expertise available whilst maintaining all possible impartiality.

Once they have been endorsed by the Board, the advisory reports are sent to those who requested them as well as to the Minister of Public Health and are subsequently published on the SHC website (www.hgr-css.be). Some of them are also communicated to the press and to specific target groups (healthcare professionals, universities, politicians, consumer organisations, etc.).

In order to receive notification about the activities and publications of the SHC, please contact: info.hgr-css@health.belgium.be.

www.css-hgr.be

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