The impact of the environment on South Africa's child and adolescent health: An overlooked health risk

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"Our people are bound up with the future of our land. Our national renewal depends upon the way we treat our land, our water, our sources of energy, and the air we breathe. … Let us restore our country in a way that satisfies our descendants as well as ourselves."

Nelson Mandela[1]

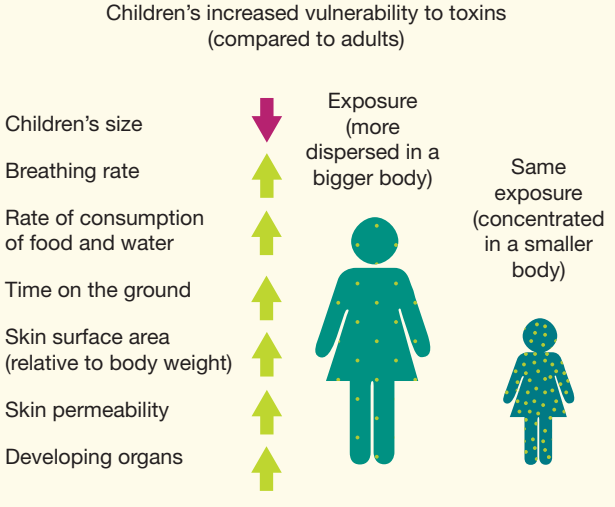
South Africa's children and adolescents live, learn and play in a multitude of environments which may either undermine or promote their growth, health and development. Environmental health studies show how the biological, physical and chemical environment negatively impacts on health, causes disease and influences behaviours. Children and adolescents are particularly vulnerable to a broad spectrum of hazardous environmental exposures (outlined in Figure 13). According to the World Health Organization (WHO), 26% of childhood deaths and 25% of the total disease burden in children under five years could be prevented through the reduction of environmental risks.[2]

Globally, there is also a change in the pattern of childhood illness from communicable to non-communicable diseases (NCDs) – many of which are caused by environmental factors and exposures. This warrants a greater focus, including the establishment of "acceptable levels" of exposure for children, and the development of child-centred policies and regulations.

Box 13: Children are not little adults

Children across all life stages, from embryo to completion of adolescence, are at varying and increased health risks from hazardous environmental exposures compared to adults for four key reasons:

1. *Different exposures*: Children are exposed through the placenta, from breastfeeding, have hand-to-mouth/object-to-mouth behaviours, breathe at a faster rate, have a higher skin surface area, are lower to and spend more time on the ground, are outside and inside over prolonged periods of time, and as adolescents engage in risky behaviours and generally have limited understanding of hazardous risks.
2. *Different physiology*: Since children at all life stages are still developing, they often have higher exposures to pollutants in air, water and food. Their developing systems have "windows of vulnerability" not found in the adult physiology.
3. *Longer life expectancy*: Children generally live longer and therefore have a longer period of exposure, a longer time for a disease with a long latency period to appear and live longer with the exposure impairment.
4. *Politically powerless*: Children have limited political voice (e.g. cannot vote) and rely on adults to make decisions to protect them from hazardous environmental risks and factors.



Source: Pacific Northwest Pollution Prevention Resource Center (2015) *How Can Daycare Facilities Minimize Toxic Exposures?* Viewed 23 October 2019: https://pprc.org/tag/flame-retardants/.

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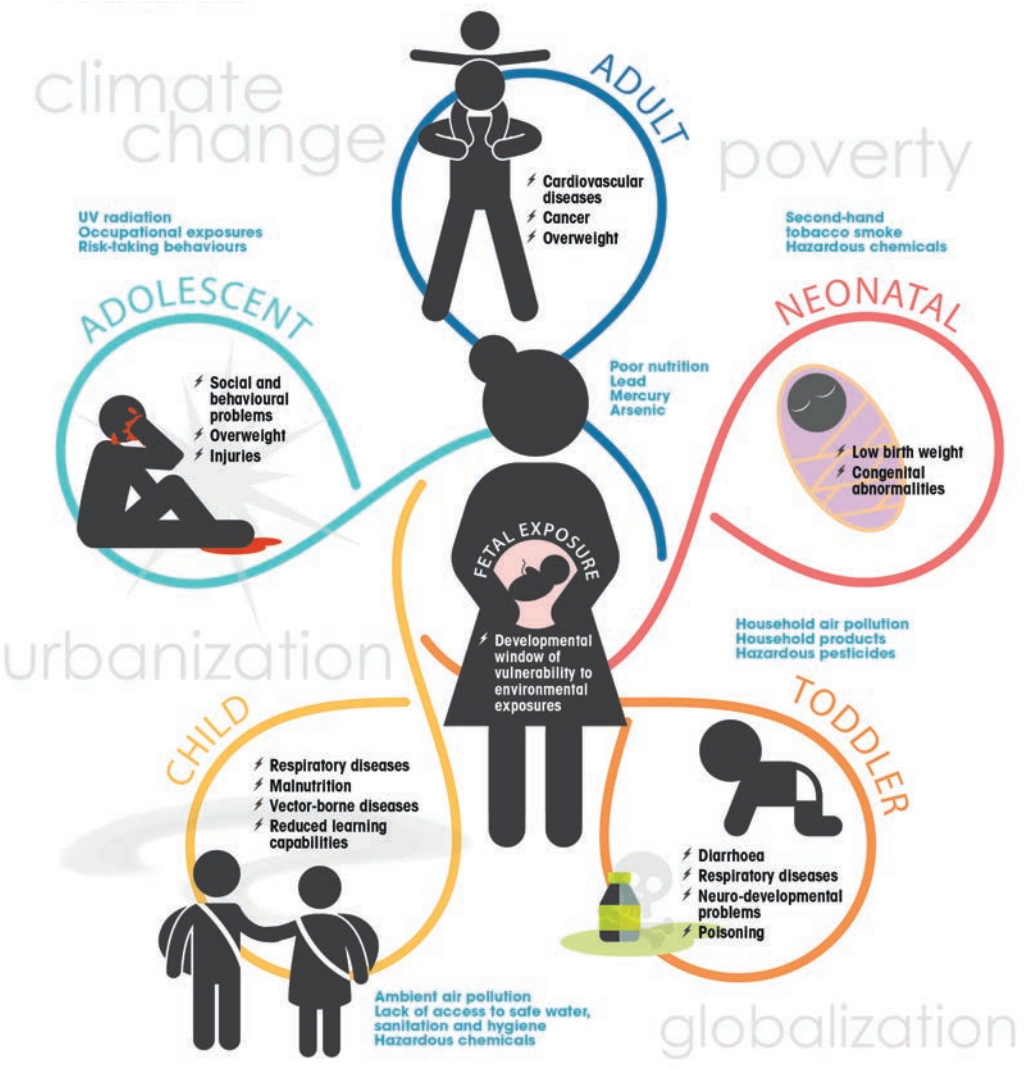
Figure 48: Environmental exposures and risk factors impacting children's health

Source: World Health Organization (2019) *Public Health, Environmental and Social Determinants of Health (PHE). Infographics: Air Pollution.* Viewed 23 October 2019: https://www.who.int/phe/infographics/air-pollution/en/

This chapter focuses on some of the key environmental hazards that impact the health of South Africa's children and how to proactively address these, namely: air pollution, chemicals, water and sanitation, and climate change. Each section briefly highlights the key issues globally and nationally, and the chapter concludes with a discussion of interventions and policies to reduce exposure risks for children. This chapter addresses the following questions:

- What are the key issues for children's environmental health?
- What are the opportunities for reducing child and adolescent exposures to environmental risk factors?
- How should the progress of recommended interventions to promote child and adolescent environmental health be measured?
- What are the key messages from this chapter?

Figure 49: Effects of environmental hazards at different life stages and windows of vulnerability



Source: World Health Organization (2017) *Inheriting a Sustainable World? Atlas on children's health and the environment.* Geneva: WHO. Licence: CC BY-NC-SA 3.0 IGO.

What are the key issues for children's environmental health?

Children are particularly vulnerable to environmental exposures since their bodies and brains are still developing. Environmental exposures start in the womb – for example, no child is born today without a multitude of chemicals in their bodies – and they continue to be exposed throughout childhood and adolescence, as illustrated in Figure 49. These exposures are predominately a result of industrialisation and consumers' demand for convenience, as well as the lack of legislation preventing children's exposure to environmental risks.

WHO has estimated that, in South Africa, 124 out of every 100,000 deaths of children under five are linked to the environment,[3] and congenital environmental disorders (caused by environmental exposures before birth) are increasing.[4] Protecting children from harmful environmental exposures, therefore, starts with protecting pregnant women from exposures at home and work.

The exposure risks of South Africa's children and adolescents need to be understood in terms of different risk factors (e.g. air pollution, chemicals) and their windows of vulnerability – the particular stages of development where these exposures pose a higher risk to children's health.

Research has shown how childhood NCDs such as respiratory diseases, cancers, neurodevelopmental disorders, type 2 diabetes, reproductive diseases, malnutrition, endocrine disruption and obesity are linked to exposure to environmental hazards (Table 26). Childhood NCDs have been associated with high-income country lifestyles in Europe

Table 26: The impact of environmental exposures on children's health, by disease

	Disease Burden	Environmental Risk / Exposure
Infectious and parasitic diseases	Respiratory infections	• Household air pollution; ambient air pollution; second-hand tobacco smoke
	Diarrhoeal diseases	• Contaminated water and lack of access to drinking water • Inadequate sanitation and hygiene
	Malaria	• Inadequate management of stagnant water and poor housing
	Intestinal worms	• Poor sanitation and hygiene
	TB transmission	• Poor housing; indoor smoke from solid fuels; second-hand tobacco smoke
Neonatal conditions and malnutrition	Neonatal conditions	• Mothers' exposures – ambient and indoor air pollution and second-hand smoke; pesticides and hair salon chemicals • Chemicals • Inadequate water, sanitation and hygiene
	Protein-energy malnutrition	• Poor water, sanitation and hygiene • Climate change
Non-communicable diseases	Cancers	• Pesticides • Chemicals (flame retardants, shampoo, nail polish remover)
	Mental, behavioural & neurological disorders	• Lead; flame retardants; plasticisers (toys, baby bottles, dummies); endocrine disrupting chemicals; pesticides • Climate change (post-traumatic stress disorder)
	Asthma	• Air pollution; indoor allergens; mould
	Congenital anomalies	• Pesticides; air pollution; endocrine disrupting chemicals
Injuries	Unintentional injuries	• Poisonings household chemicals and cosmetics • Drownings; road traffic accidents
	Intentional injuries	• Increased violence related to persons with high blood lead levels

Source: World Health Organization (2017) *Inheriting a Sustainable World? Atlas on Children's Health and the Environment*. Geneva: WHO.

or North America. However, research has shown these have spread to low- and middle-income countries including South Africa. Furthermore, many NCDs are climate sensitive and will be amplified by the impacts of climate change (e.g. extreme heat, floods, wildfires, air and chemical pollution). Given the increase in early child exposure to environmental toxins, more children are developing NCDs previously associated with adults (e.g. type 2 diabetes).

Environmental exposures have also been linked to transgenerational *epigenetic* changes (see chapter 2) resulting in an increase of NCDs. For example, maternal smoking, chemicals in plastics, persistent organic pollutants and heavy metals are associated with neurodevelopmental disorders in children.[5] This information needs to guide prevention strategies, policies, legislation and regulations to protect children and adolescents during these windows of vulnerability. It is also important to consider the context within which exposure risks occur. For example, in rural areas children are more likely to be exposed to indoor air pollution from wood and solid fuels while children in urban areas are more exposed to indoor air pollution from liquid fuel (such as paraffin) and outdoor air pollution from vehicles, industry and power generation.

Air pollution: The air that children breathe

South African children are exposed to air pollution inside (household) and outside (ambient) their homes and schools. Disease risks from these exposures are high for children even at extremely low levels of exposure because they are particularly vulnerable at different stages of development. For example, WHO indicated that over 600,000 children globally died from air pollution-induced respiratory infections in 2018, yet there is limited research about South African's children.[6] Globally, 92% of adults and children breathe ambient (outdoor) air that exceeds WHO limits.[7]

Children in Cape Town, particularly those living in low socio-economic communities, are exposed frequently to brown haze pollution. This haze is made up of pollutants from transportation, fuel (paraffin and wood), industrial processing, windblown dust, and the disposal of solid waste. There is also

Figure 50: WHO Global statistics on the impact of air pollution on children

Source: World Health Organization (2019) *Public Health, Environmental and Social Determinants of Health (PHE). Infographics: Air Pollution.* Viewed 23 October 2019: https://www.who.int/phe/infographics/air-pollution/en/

concern that adolescents inhale large quantities of polluted ambient air during outdoor activities – sports, exercise, walking – increasing their health risks for respiratory diseases, cancers and adult heart disease.

The extensive use of solid fuels is a key risk factor for children's exposure to household air pollution. Children living in rural areas of KwaZulu-Natal, Limpopo and Eastern Cape provinces[8] are particularly exposed to toxic fumes due to the widespread use of wood and coal for cooking, which releases hazardous chemicals such as dioxins which may cause respiratory disease. Additional indoor air pollutants include second-hand cigarette smoke; gases released by furniture, carpets, plastics (i.e. giving off a hazardous chemical); lead in paint; chemicals for cleaning; pesticides; and fungal spores.

Asthma, an NCD impacted by environmental triggers, is reaching epidemic proportions. Recent studies revealed

Case 22: The interdependency between children's best interests and right to a healthy environment

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A single constitutional value system

Section 24 (a) of the Constitution[9] guarantees everyone's right to an environment that is not harmful to their health or wellbeing, and Section 24 (b) requires the environment to be preserved for the benefit of *present and future generations* through reasonable legislative or other measures (own emphasis).

These provisions need to be read in conjunction with, section 28 (2) of the Constitution which states that the best interests of a child are of *paramount* importance in every matter concerning the child (own emphasis). The 'best interests of the child' is both an independent right, and general principle that should guide the implementation of all other rights afforded to children.[i] In other words, sections 28 (2) and 24 of the Constitution are interdependent. This means that the state, and to an extent, organisations and individuals, don't only have a constitutional obligation to protect children from environments that are harmful to their health and wellbeing. They also have a heightened obligation to do so in the best interests of children, who are particularly vulnerable to environmental hazards such as the impact of air pollution. The state, in particular, is required at all times to respect, protect, promote and fulfil these rights.[10] This includes putting measures in place to regulate the private sector and protect children from harm as outlined in the UN Committee on Children's Rights General Comment 16 on the state's responsibilities regarding the impact of the business sector on children's rights.

Air pollution – a 'public health emergency'[11]

The best interest principle has been used by the Constitutional Court to interpret and strengthen a number of rights enshrined in the Constitution,[12] but has not yet been used in the context of section 24. This fundamental interdependency has come to the fore in the "Deadly Air" case instituted in the Pretoria High Court by two non-governmental organisations, groundWork and Vukani Environmental Justice Movement in Action. The application against government concerns the dangerous levels of outdoor air pollution in the Mpumalanga Highveld Priority Area which is harmful to people's health and well-being.[13] As children are developing, they inhale more air than adults,[ii] absorbing more pollutants as a result.[14] In some cases the effects of air pollution can cause premature death as illustrated in Figure 3. A 2019 expert study shows that the dangerous levels of air pollution in the Mpumalanga Highveld Priority Area are primarily caused by emissions from facilities operated by Eskom and Sasol, South Africa's biggest polluters.[15]

The "Deadly Air" court application introduces evidence of the link between section 24 and section 28(2) in two ways. This evidence provides the foundation for further legal argument as the case progresses:[16]

- it draws on scientific evidence to describe the health impacts of air pollution, especially on children at sensitive locations, such as primary schools; and
- it presents supporting testimonies from affected individuals who describe how the toxic air pollution affects their daily lives – these include a mother of two young children who are dependent on oxygen in order to sleep at night due to their chronic asthma.

Consequently, the "Deadly Air" case highlights the aggravated impact of air pollution on the developmental needs of children, including sleep and their educational environment, among others. To reduce these daily impacts, the case simply calls on the South African government to take available steps to implement and enforce the air pollution laws and the air quality management plan, which are already in place. For the sake of the children, and the general public, residing in the Mpumalanga Highveld Priority Area, it is high time that their basic rights are protected, as guaranteed by the Constitution.

i Article 3 of the United Nations Convention on the Rights of the Child is also clear that the best interests of the child shall be the primary consideration in all actions concerning the child. This includes actions by all public and private institutions whose work and decisions impact on children and the realization of their rights from social welfare institutions to courts of law, administrative authorities and legislative bodies.

ii Children take in more air per unit of the bodyweight than adults *see* UNICEF (December, 2017) *'Danger in the Air: How air pollution can affect brain development in young children'* at p 4. Available at https://www.unicef.org/sites/default/files/press-releases/glo-media-Danger_in_the_Air.pdf

Table 27: Multiple pesticide exposure risks for South Africa's children

Agriculture • Crops; horticulture, weed control, chicken feed fly control	**Public health** • Malaria; community pest control
Borders • Mosquito control on airplanes, phytosanitary (health of plants for international trade) and foot/mouth disease control	**Public spaces** • Schools, hospitals, office buildings, public buildings (supermarkets, restaurants), landfills, weed control on pavements
Domestic • Home and garden use, lice shampoo, paints, hand wash	**Transport** • Land and sea movement of pesticides; treated boat hulls
Forestry • Treated timber, alien invasive vegetation removal	**Veterinary purposes** • Livestock, domestic pets, foot and mouth disease
Leisure areas • Hotels, golf courses	**Unregistered uses** • Street pesticides, self-harm, problem animals, homicides, warfarin (a heart medication which is a pesticide) in street drugs
Laboratories • Research, export residue testing	**Migratory pest control** • Quelea birds, locusts

Source: Rother H-A (2012) Improving poisoning diagnosis and surveillance of street pesticides. *South African Medical Journal, 102(6)*: 485-488.

that nearly half of South Africa's children living in urban communities experience serious symptoms of asthma[17] and 92% of child asthma cases globally are linked to nitrogen dioxide exposures related to air pollution, often from motorized transport.[18]

A study of school children in Durban, one of the most polluted industrial cities in southern Africa, found that children from industrial communities were more likely to experience respiratory problems such as asthma.[19] Air pollution in South Africa also increases health-care costs, especially for children who may develop chronic respiratory effects or have to be hospitalised with acute asthma attacks. Case 22 illustrates how the hazardous exposures associated with outdoor air pollution violate children's rights.

At the conclusion of the WHO Global Conference on Air Pollution and Health in 2018, it was emphasised that ambient and indoor air pollution are responsible for seven million deaths each year (with 93% of children globally breathing in highly polluted and hazardous air) and that most of these deaths are preventable.[20] South Africa needs to heed this call with urgency and take action to protect children's health as air pollution exposures and their impact on health are being amplified by climate change. This raises questions about the conservative approach adopted by the new Carbon Tax Act which may fall short and take too long to produce a meaningful improvement in air quality.

Chemicals: Where does exposure begin and end?

The 2017 Lancet Commission on Pollution and Health identified chemical pollution as an emerging global health risk for children.[21] South African babies born today have chemicals in their systems – from dichlorodiphenyltrichloroethane (DDT) which is used for malaria control in four provinces to phthalates found in plastic packaging, pipes, medical tubing and toys. While South Africa's fragmented legislation regulates some chemicals, children and adolescents are not adequately protected from hazardous exposures during key developmental windows of vulnerability.

The list of chemical exposures for South Africa's children is extensive as outlined in Table 26. Lead, a neurotoxin, was removed from local petrol but it has been more difficult to ensure that it has been removed from paint due to lack of enforcement of current legislation, and it continues to be used in, for example, bullets and fishing sinkers.[22]

These chemicals have been linked to a global increase in childhood brain cancers, asthma, leukemia, early onset of puberty, attention deficit hyperactivity disorder (ADHD), genital disorders in boys, and life-threatening birth defects. This includes exposure to endocrine-disrupting chemicals which is an emerging area of concern (Box 14).

Yet, less than 20% of chemicals globally have been assessed for impacts on child development. Furthermore, research in South Africa is limited by a lack of funding and a failure to recognise the urgency and extent of the problem.

In South Africa there is a "culture of chemical use" where there is widespread use of chemicals to keep homes and businesses germ-free, with limited understanding of the potential dangers to human health and the environment. There is also a blind assumption that government regulates all chemicals in products used in South Africa. Yet, this is not the case (and discussed later in this chapter).

Pesticide use in South Africa is extensive across multiple sectors increasing the risk of child exposure (Table 27). Neither the main South African pesticide legislation[25] nor

Box 14: Endocrine-disrupting chemicals (EDCs) exposure in South Africa: An emerging issue of concern

Global research has highlighted that many of the chemicals that South Africa's children and adolescents are exposed to are EDCs – which interfere with normal hormonal process (e.g. sex hormone, thyroid) and have health effects across the life course of the child.[23] In 2011, South Africa became the first African country to prohibit the production, import, export, and sale of baby-feeding bottles which contain bisphenol A (BPA) because of its effects on behavioural disorders and diabetes.[24] More action is needed to prevent other EDC exposures, for example, from pesticides such as DDT (found in Limpopo in breastmilk and chicken eggs); brominated flame retardants (BFR) in mattresses, car seats, car interiors, baby strollers, pads used on baby changing tables and furniture; BPA in food and beverage packaging, linings of metal food cans and bottle tops; phthalates in plastic food wrap and toys, lead in paint and fragranced products such as shampoo, cosmetics and air fresheners.

Source: Bornman MS, Aneck-Hahn NH, De Jager C, Wagenaar GM, Bouwman H, Barnhoorn IEJ, Patrick SM, Vandenberg LN, Kortenkamp A, Blumberg B, Kimmins S, Jegou B, Auger J, DiGangi J & Heindel JJ (2017) Endocrine disruptors and health effects in Africa: a call to action. *Environmental Health Perspectives*, 25(8): 085005-1-085005-10. https://doi.org/10.1289/EHP1774

the 2010 Pesticide Management Policy provide clear limits to protect children from risky exposure. Several high-income countries, however, include additional safety measures to protect children or ban certain types of pesticides known to be highly hazardous for children. Yet the South African legislative framework is fragmented with 14 pieces of legislation under seven government departments regulating some aspect of pesticide use.

Commercially sold pesticides and some household chemicals have warning labels that include the chemical names, hazards, risks, warnings and precautions. However, South Africa does not have a culture of reading labels and, even if an end-user reads the label, comprehension of the information is low and not promoted (Box 15).

The case of street pesticides

Agricultural pesticides are illegally decanted and sold in the informal sector for household pest control.[26] The sale of these *street pesticide*s is prolific and results in child poisonings, self-harm and homicide in all South Africa's urban centres.[27] The poisonings and death of children are concentrated in poor communities where poor-quality housing, limited refuse collection, and insufficient sanitation and water facilities aid the proliferation of urban pests such as rats, cockroaches, bed bugs and flies. These living conditions create a massive demand for highly hazardous pesticides that are too toxic for domestic use and violate children's rights to a safe and healthy environment. This highlights the need for multisectoral collaboration to address the epidemic of child deaths and prevent the long-term health from acute poisonings.

Water pollution, sanitation and hygiene: Undermining child survival

Ensuring consistent access to safe water, sanitation and hygiene facilities at home, in schools and in health-care facilities is a pre-requisite for children's survival and sustained growth. Regular bouts of diarrhoea amongst young children reduce their ability to absorb critical nutrients and irreversibly impede their physical and mental development. Consuming unsafe water and walking long distances to use a poorly constructed toilet, where one exists, put the lives of children in South Africa at risk every day. When South Africa enshrined the rights to a healthy environment and basic water and

Box 15: The right-to-comprehend chemical information

All legally registered pesticides in South Africa must contain a label with a registration number, product and company information, as well as health and safety advice and warnings. This forms part of the right-to-know principle. That is, the user has the right to have access to information about the hazard and risks associated with a pesticide product.

In South Africa, with 11 official languages and varying literacy levels, access to hazard and risk information is not enough to prevent short- or long-term exposure risks. Thus, there is a need to promote consumers' right-to-comprehend, for example by ensuring that the comprehension of warning labels is incorporated into primary and secondary school curricula. Another mechanism could be to require industry to translate the label information into different languages as an insert or as posters where the product is sold. If consumers do not have the means to understand information about hazardous chemicals, then the label is simply protecting industry from liability and failing to protect children and their caregivers from hazardous exposures.

Source: Rother H-A (2018) Pesticide labels: Protecting liability or health? – Unpacking "misuse" of pesticides. *Environmental Science and Health*, 4: 10-15.

sanitation, this put the country on a strong trajectory towards ensuring equitable access to water, sanitation and hygiene, for all. Much progress has been made in increasing access to water and sanitation services, yet significant differences remain within and between rural and urban areas and provinces, and between rich and poor households.

From 2000 to 2017, the proportion of people with access to an improved water source in South Africa increased from 87% to 96%. However, the standards for this access have not been maintained at the same rate. While access to an improved water source within 30 minutes (defined as a basic water service) increased in both rural and urban areas, the percentage of households with access to a water service which was "available when needed" declined over the same

Case 23: Using audits to improve access to sanitation in Gauteng's public schools

Hopolang Selebalo, Angela Bukenya, Roné McFarlane and Sibabalwe Gcilitshana (Equal Education)

South Africa had to reckon with the desperate state of sanitation in its rural public schools after two young learners drowned in pit latrines in recent years.[28] While rural provinces such as Limpopo, KwaZulu-Natal and the Eastern Cape are battling to eradicate thousands of dangerous pit latrines, Gauteng has already eradicated such backlogs.[i] Yet, the non-governmental organisation Equal Education's (EE) 2018 report on school sanitation in Gauteng[29] describes how poorly constructed toilets, high learner-to-toilet ratios and limited maintenance and upkeep of facilities[30] continue to undermine the health, safety and dignity of learners – particularly those from poor and working-class households. As one learner expressed: "my dignity is not there anymore, because of the dirty toilet I have to go to every day." Female learners were concerned about the lack of doors – or functioning locks – on their toilets.

The World Health Organization highlights that adequate access to these services combats disease, safeguards learners' ability to learn and ensures that learners of different genders and abilities are not discouraged from attending school.[31]

Gauteng sanitation campaign

Following EE's School Sanitation Campaign and the promulgation of the National Norms and Standards for School Infrastructure in 2013,[32] the Gauteng Department of Education prioritised the upgrading of school sanitation facilities.

In 2015, the Minister for Education in Gauteng promised to upgrade sanitation conditions in 50 of the worst-affected schools in the province. This came after EE and other civil society organisations conducted a social audit of sanitation facilities at over 200 schools in Gauteng.[ii] Three years later, EE visited 38 of the upgraded schools and found persistent challenges.[33]

Only 19 schools complied with the norms and standards and had learner-to-toilet ratios of less than 37:1 for primary schools and 34:1 for secondary schools[iii].[34] Many toilets were broken, leading to ratios in excess of 51 learners per working toilet at 20 schools. Seven out of 10 toilets did not have locking doors, nine schools had no bathrooms for learners with physical disabilities, and at 15 schools more than one third of the taps were broken.

EE's school audits highlighted the need to move beyond the mere provision of sanitation facilities, and the role of civil society in holding government to account; and focusing on more systemic issues that contribute to the deterioration of the infrastructure provided. This includes poor quality of work carried out by contractors hired by the Gauteng government, and poor maintenance of sanitation facilities. Without such a focus, schools and provincial education departments will remain caught in an unending cycle of sanitation upgrades.

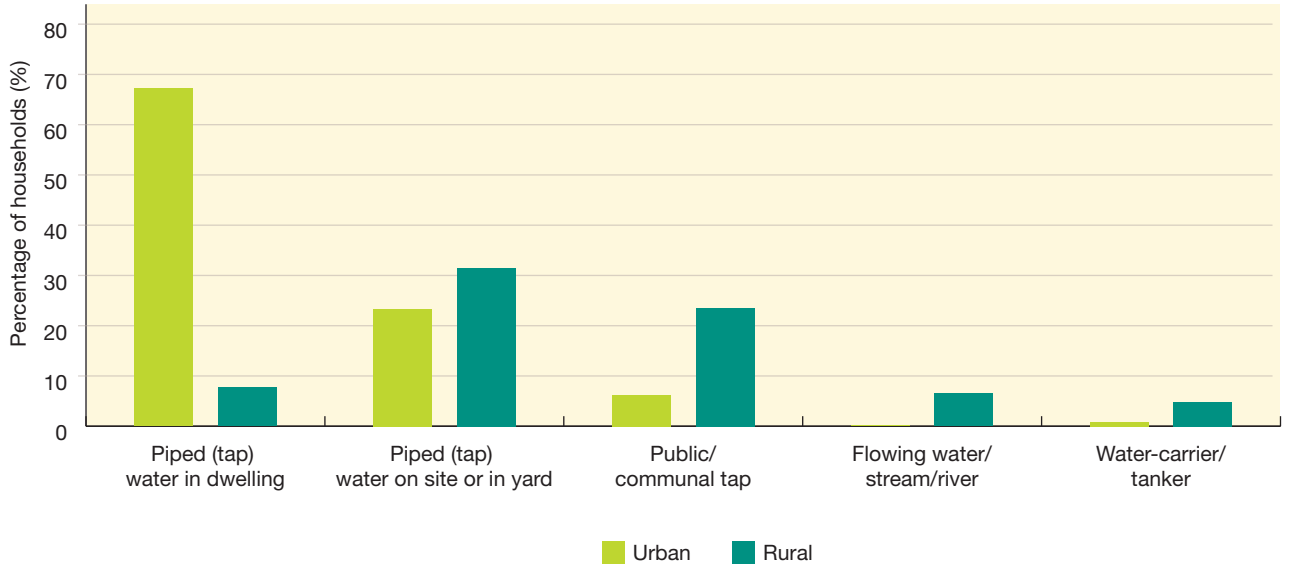
The school audits also identified that a lack of sanitary pads hindered girls' ability to attend school with girls constantly having to catch up on their schoolwork. As a result, EE called for the provision of menstrual hygiene products in poor schools and the zero-rating of sanitary pads. In the 2018 Medium Term Budget Policy Statement, Finance Minister Tito Mboweni announced that sanitary pads would no longer be taxed, and that the provision of sanitary pads in schools would be funded through increases to provincial funding. However unless this funding is ring-fenced, there is no guarantee that the funds will be used to provide sanitary towels in schools.

i According to the 2018 National Education Infrastructure Management System report, no schools in the Gauteng Department of Education are currently in violation of the norms and standards for sanitation.

ii The social audit assessed the sanitation conditions of 200 schools across Gauteng. It was conducted by the Gauteng Education Crisis Committee – a coalition which consisted of organisations such as Alexandra Civic Organisation, BuaFunda and the Gauteng Civic Association, amongst others. The coalition was led by Equal Education.

iii These ratios refer to schools with the largest enrolment range.

Figure 51: Main sources of drinking water in rural and urban areas, 2017



Source: Statistics South Africa (2018) *General Household Survey 2017*. Pretoria: Stats SA.

period – from 64% to 50% in rural areas; and from 94% to 82% in urban settings. As a result, the share of households in urban areas with access to a safely managed water service has declined from 90% to 82% between 2006 and 2017, despite this being an indicator of the Sustainable Development Goals (SDGs). The increase in time to collect water, and the unpredictability of the service have a negative impact on the amount of water available for consumption and hygiene.

Over the same period, there have been tremendous improvements in access to basic sanitation facilities in both rural and urban areas. However, 7% of people in informal dwellings still practice open defecation primarily due to a lack of convenient access to hygienic sanitation facilities. Where open defecation, poor drainage and high population densities occur simultaneously, it increases the risk of gastrointestinal infections, worms and cholera, particularly for children. Safety and hygiene are a continued concern for women and young girls using shared toilets, and the situation of children with special needs in informal settlements is particularly stark.[35]

Significant disparities persist between provinces, income quintiles and settlement types. For example, access to water in the home is particularly limited in rural areas (as illustrated in Figure 51) with significant implications for water consumption and the time required to collect water.

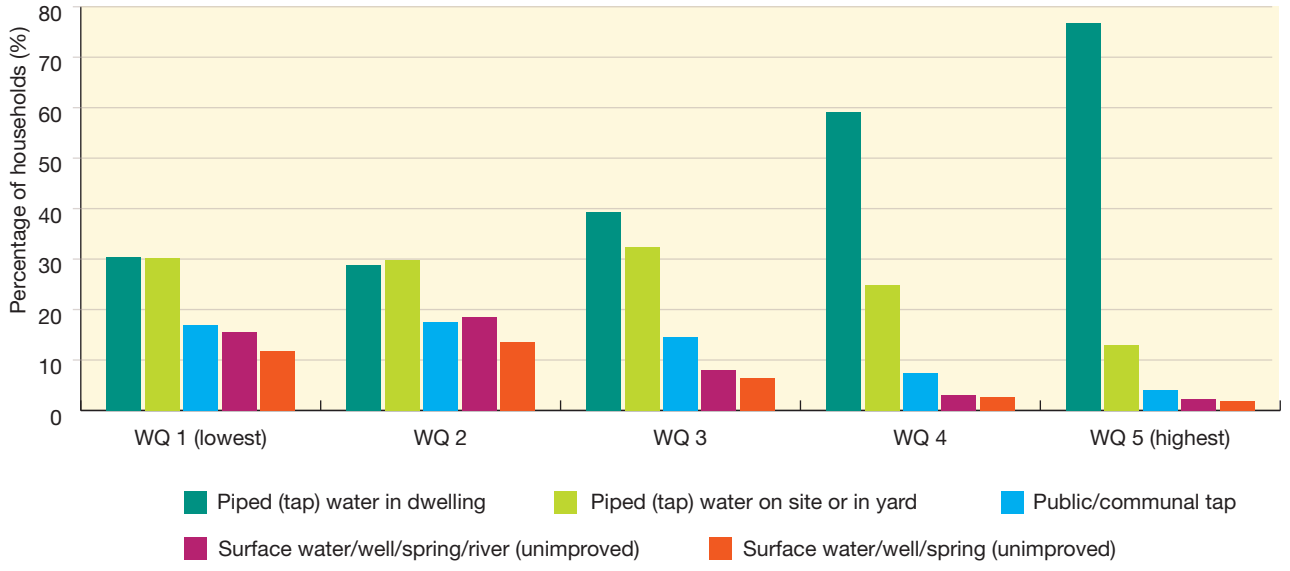
Figure 52 highlights significant differences in standards of water services across different wealth quintiles. It shows that poor households are more likely to use shared sources (communal taps) and surface water (with associated water quality concerns), while wealthy households are most likely to have access to water in their homes. Improving the most vulnerable households' access to a basic water service, and progressing to safely managed water services, is critical for the health and optimal development of children.

The tragic deaths of two young learners in school pit latrines highlight ongoing concerns around school sanitation. Schools without adequate water, sanitation and handwashing facilities impact on learners' health, safety, attendance and productivity. While over 99% of South African schools have access to water and sanitation facilities, only 78% have a basic water service (improved and available water facilities). In rural areas, 9% of schools are reported to have no sanitation facility. Furthermore, there are no data on the proportion of schools with basic sanitation facilities (improved, usable, single-sex toilets) or menstrual hygiene facilities. School water and sanitation audits therefore have an important role to play in identifying gaps and advocating for quality improvement as illustrated by the work of Equal Education in Gauteng (Case 23).

Health-care facilities that lack safe water, toilets and hygiene materials can detrimentally impact the health of mothers, babies and young children. While data is extremely limited, the Joint Monitoring Programme found that only 42% of non-hospital facilities had handwashing materials beside the toilets. There were no data on handwashing materials at the point of care, and only 78% of waste from non-hospitals was being treated or disposed of safely.[36]

Whilst much progress has been made in achieving basic

Figure 52: Main sources of drinking water across the wealth quintiles, 2017



Source: Statistics South Africa (2018) *General Household Survey 2017*. Pretoria: Stats SA.

levels of service, significant efforts are required to ensure that all South African children can benefit from their *right to water and sanitation* at home, in school and in health care facilities. Considerable and sustained investment is needed to improve the quality, reliability and accessibility of services in line with the SDG benchmarks for safely managed drinking water and sanitation, and to address outstanding challenges by prioritising services for the poorest and most vulnerable children.

Climate change: The greatest health challenge in the life course of children and adolescents

Even though South Africa has made considerable progress in increasing access to water and sanitation, the impact of climate change poses a significant risk to these achievements. Changes in climate may detrimentally affect children's development and growth in South Africa. These changes are most likely to affect children from the poorest quintiles, those living in rural areas and informal settlements, and those with special needs.

In South Africa, the impacts of climate change have been referred to as "predominately a health issue".[37] Droughts and extreme weather events (EWE) will increase in frequency and intensity and will detrimentally affect food security and the nutritional status of the most vulnerable children. Furthermore, climate change will increase the incidence and distribution patterns of vector-borne diseases such as malaria, schistosomiasis and dengue fever.[38] Other inherent physical risks include dehydration, drowning, physical injury, exposure to polluted water, and increased violence.[39]

EWE (e.g. floods, storms, wildfires) may impede access to, or destroy, health-care facilities and negatively affect the provision of health-care support to children, including those affected by HIV. Table 28 provides a brief overview of the wide-ranging impact that climate change and climate variability are having on the health of children and adolescents in South Africa.

Water scarcity will further undermine water quality and increase costs, as well as the time needed to collect water, and may force vulnerable households to make difficult choices about the education and future of their children, particularly girls. The recent Day Zero water crisis in Cape Town served as a global wake-up call to the impact of climate change on available water resources and the ever-increasing challenge of rapidly expanding urban growth due to migration. The situation also highlighted the need – and potential – to conserve water, reduce leakages, use water more efficiently, reuse water and tap into alternative water sources, as well as for the need for water resilience planning (Box 16).

Despite the multitude of health risks for South Africa's children and adolescents associated with climate change, the Department of Environmental Affairs' draft National Climate Change Adaptation Strategy[40] does not mention children once. Although the national Department of Health's draft National Climate Change and Health Adaptation Plan (2020 – 2024)[41] mentions children, there is no recognition that children's windows of vulnerability and exposure risk factors need targeted interventions and strategies. The 2018 draft Climate Change Bill[42] makes limited reference to future generations but no specific reference to protecting children's

Table 28: Examples of South African children's exposure and vulnerability to climate change impacts

Climate-induced Health Risk	Examples of health impact
Direct health impacts	
Extreme heat stress	Sports, playing outside, heat in schools and outdoor child labour can increase dehydration, overheating and heat stroke; and sun stroke and ultraviolet radiation exposure. Domestic and gang violence increase with increased heat.
Insect-related diseases	Higher temperatures lead to increasing population of insects as well as their expansion into places where children play and live. For example, there have been studies on increases in the prevalence of dengue fever, cholera and malaria, and in new geographical areas.
Malnutrition	Increased pollution and heat stress lead to reduced physical activity and obesity. Extreme weather events (EWE) reduce food production and affordability of nutritious food (undernutrition). The increased cost of water (due to water scarcity) reduces household expenditure on other items such as food and may force families to make difficult decisions about school attendance or child labour.
Diseases linked to air pollution	Increased exposures to ground-level ozone, poor air quality, longer pollen seasons, expansion of allergenic vegetation, mould leading to asthma, rhinosinusitis, allergic diseases and cancers.
Diseases linked to chemicals	Increased exposure to chemicals, due to flooding, increased vaporisation and volatilisation of chemicals exposed to heat, and increased use of endocrine-disrupting chemicals to combat a rise in pests.
Exposure to allergens	Playing, walking, and sports/activities outside increase dust exposure from drought and storms, mould growth from floods, and longer and severe pollen seasons.
Mental health strain	Post-traumatic stress disorder and depression linked to EWEs (e.g., floods, drought, storms).
Violence	Increased domestic and gang violence linked to temperature increases.
Injury	Increased violence, crime and traffic injuries linked to heat increases and EWE, as well as physical harm (e.g. drowning).
Snake bites	Increased bites occurring in urban areas, as migratory patterns change. WHO launched a prevention strategy in 2019 to highlight this neglected NCD.[43]
Indirect health associations	
Increased water scarcity	Reduced volumes of water available for consumption, deteriorating water quality associated with scarcity, and further distances to walk, with associated protection risks for children.
Rising sea levels	Increased salinity of water in coastal areas due to rising sea levels can detrimentally affect the health of children, mothers and unborn children.
Water-related diseases	Increased water pollution where children bathe, drink and play; storms and floods contaminate drinking water.
Reduced access to water and sanitation services	Increased flooding and EWE can damage water facilities, causing disruption of services as well as possible damage to sanitation facilities, further increasing the risk of contamination of water sources.
Reduced access to schools and health-care facilities	EWE and flooding can damage and lead to the closure of schools and health care facilities; or schools become response centres and the school term is interrupted or suspended for significant periods of time. Also resulting from children migrating to other locations because of climate impacts.
Child poverty and inequality	Flooding in urban settlements, and increased overcrowding from rural to urban migration as agricultural production is impacted by drought.

health. Yet children are particularly susceptible to shock and stress and have the highest health risks given the length of their life course; so it is not sufficient to just refer to them as "vulnerable populations" in policies. Children are the "canary in the mineshaft of climate-linked disease outcomes" and their specific needs should be explicitly addressed in all relevant policies.[44] Youth climate activists can be influential in protecting the current and future generations' health from the impacts of climate change (Case 24). It is therefore encouraging that young people are finding their voice and protesting against the threats to their environment.

Box 16: UNICEF recommendations for climate resilient water for South Africa

UNICEF has extensive experience in designing and implementing climate resilient programmes globally, and is advocating for the following interventions to minimize the risk of climate change for the most vulnerable children in South Africa:

- ✓ Undertake a **climate risk assessment** to identify the most vulnerable children and the most vulnerable areas – this could be done using the Strategic Framework for WASH Climate Resilient Development which UNICEF developed in collaboration with Global Water Partnership.
- ✓ Revise the **National Adaptation Strategy** to highlight the needs of the most vulnerable children.
- ✓ **Scale up solar powered water systems** to reduce walking times, and increase energy efficiency and functionality.
- ✓ **Increase water service levels** to reduce the walking distance and waiting times for informal settlements, and the most vulnerable families, ensuring that interventions are climate resilient.
- ✓ **Integrate water safety planning into climate resilient programmes.**
- ✓ Develop an **investment case for climate resilience**, with evidence on the cost of inaction and the impact on the economic future of South Africa.
- ✓ Undertake **mobilisation campaigns to deter excessive water consumption** and to reduce the gap between the richest and poorest households.
- ✓ Introduce **water accounting** to ensure that domestic water supply is prioritised over other needs.
- ✓ **Document the impact of inadequate access to safe and sustainable WASH facilities** in schools and health-care facilities.
- ✓ **Develop a road map** on how to scale up and improve WASH facilities to meet national and global standards while being climate resilient.

Source: UNICEF & Global Water Partnership (2014) *WASH Climate Resilient Development Strategic Framework.* New York: UNICEF/GWP.

What are the opportunities for reducing child and adolescent exposure to environmental hazards?

It is essential to mitigate against – and adapt to – climate change in order to reduce the impact on health. From a public health perspective, mitigation corresponds to primary prevention and includes efforts to reduce greenhouse gases, invest in green energy (e.g., solar and wind power), reduce the carbon impact of farming, and develop sustainable chemistry. Adaptation strategies include both secondary prevention (e.g. early warning systems) and tertiary prevention (focused on reducing diseases).[45] This section focuses on adaptation strategies to reduce risks for children and adolescents.

Prevention must occur simultaneously at the international and national policy level as well as the community and individual level – and it extends from global and national policies to the provision of safe alternatives and information to children and caregivers. It is essential to promote collaboration with other sectors and give more prominence to environmental health within the health sector to address the environmental determinants of child and adolescent health, and to build a more resilient, responsive and child-centred health care system. Furthermore, the impact of industry on children's health must be critically evaluated as self-regulation does not replace the need for strong legislation to control environmental exposures. Civil society campaigns that directly or indirectly protect children's health play a key role in mobilising communities at the grassroots. Given that new research regularly highlights new environmental health risks, prevention is paramount in protecting children from environmental exposures (Figure 53).

Integrate children and environmental health in all policies (CEHiAP)

Child and adolescent exposure risks need to be explicitly addressed by a wide range of policies and legislation that cut across different sectors (e.g. health, environment, agriculture, water, education, social welfare) as children's environmental health cannot be addressed by the health sector alone. These policies should adopt a precautionary approach and should draw on international evidence to protect children from all potential environmental hazards. It is essential to set the limits for exposure at levels that protect developing children from harm, and these child-sensitive measures will in turn provide adults and other vulnerable populations with protective legislation and regulations. Less hazardous alternatives should also be a goal of these policies to prevent exposures.

Currently, the policies and legislation in place are not sufficient to protect children and adolescents from chemicals, air pollution, poor water and sanitation, and climate change.

Case 24: Children's climate power – "We are fighting for our lives"

> *"You have failed us in the past. If you continue failing us in the future, we, the young people, will make change happen by ourselves. The youth of this world has started to move and we will not rest again."*[46]

Climate activism in 2019 has been taken to a new level with children and adolescents hitting the streets to lead the demand for greater reduction in carbon emissions, highlighting how the failure to take climate action is violating children's rights, and calling on the United Nations Committee on the Rights of the Child to hold governments accountable.

"Thirty years ago, world leaders made a historic commitment to the world's children by adopting the Convention on the Rights of the Child. Today, the world's children are holding the world accountable to that commitment," said UNICEF Deputy Executive Director Charlotte Petri Gornitzka. "We fully support children exercising their rights and taking a stand. Climate change will impact every single one of them. It's no wonder they are uniting to fight back."[47]

These children are voicing their anger at how adults are handling the climate crisis in a manner that will negatively impact on their future.

> *"It is still not too late to act. It will take a far-reaching vision, it will take courage, it will take fierce, fierce determination to act now, to lay the foundations where we may not know all the details about how to shape the ceiling. In other words, it will take cathedral thinking. I ask you to please wake up and make [the] changes required possible." (Thunberg addressing European Parliament's Committee on the Environment, Public Health and Food Safety in April 2019).*

In 2018, Greta Thunberg, a Swedish teenager, started sitting outside the Swedish parliament every Friday to call for immediate action to address climate change. Her call to action drew media attention and catalysed a global movement led by children and youth – with an estimated 1.4 million students in 112 countries joining the school strike for climate change. Greta highlights that although children cannot vote, they can use their voice and activism in other ways to hold adults, particularly government officials, accountable for their actions that impact on the lives of children and future generations. What her activism has also achieved is that the global conversation on climate change has significantly increased amongst the general population (even including climate denialists), which published climate science research has not.

In South Africa, since March 2019, children have been taking to the streets to demand government urgently address the issues of waste, pollution and the country's dependency on non-renewable energy. Children may lack political voice, but they have used collective global action to advocate for *intergenerational justice*. They are demanding a child-rights approach to climate change as they will be most impacted by the decisions adults are making today.

In her 2019 budget speech, Minister of Environment, Forestry and Fisheries, Barbara Creecy, stated: "Our debate takes place today, in a context which in recent times has seen school children across the world, including in our own country, organising strikes to demonstrate against adult inaction to address the risks irreversible and dangerous climate change pose to their futures. These young people insist that we talk about a climate emergency and not about climate change."

Now it is time to see what arises from youth climate activists and government's response to this activism.

In theory, the 2013 National Environmental Health Policy should serve as an overarching policy for children's environmental health rights and climate change. In practice, the current policy seems to have little impact. Although many relevant issues are discussed, other policies and legislation (as captured in Table 29) do not reference the environmental health policy.

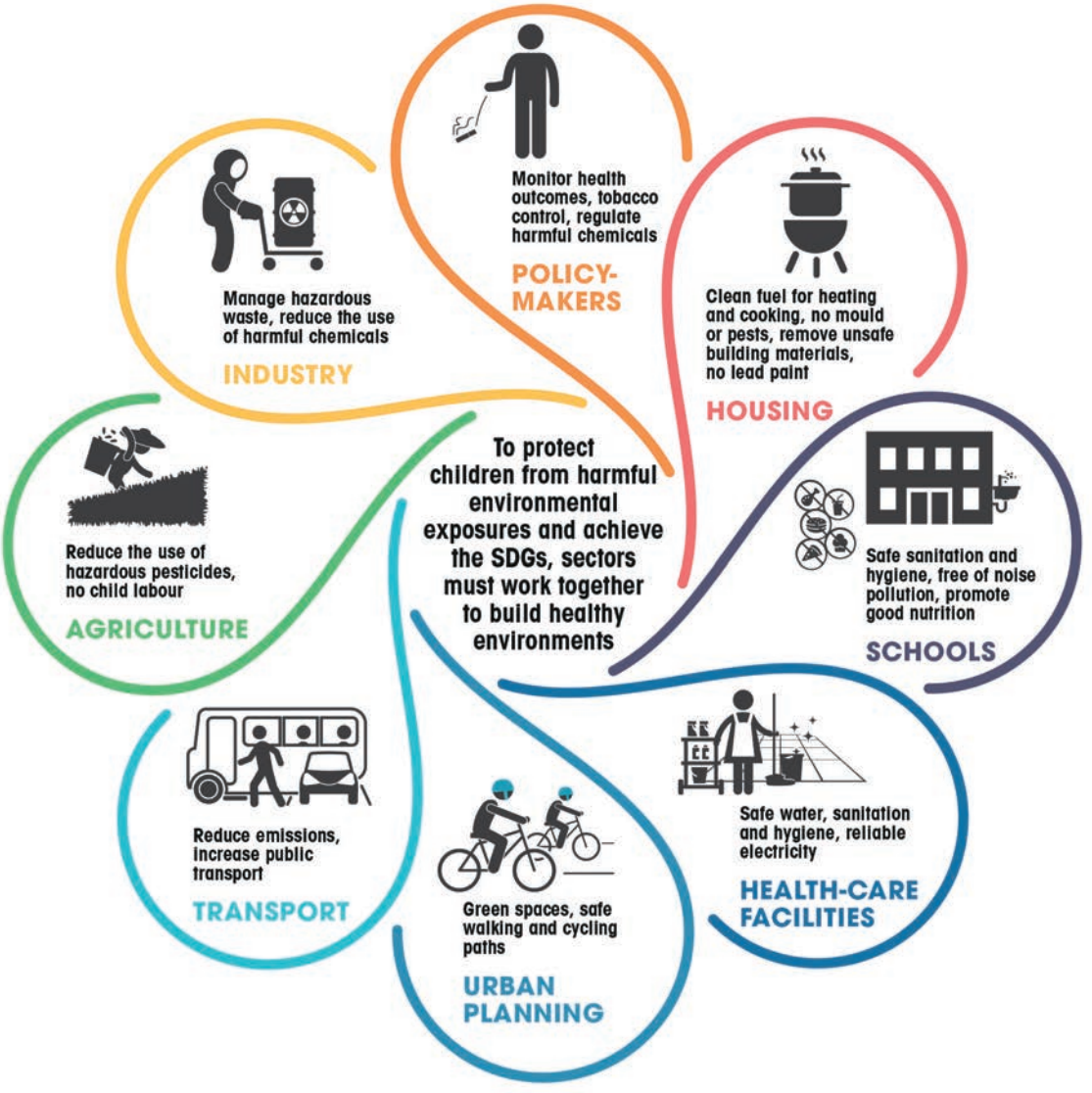
Achieving many of the SDGs and targets, as well as implementing the corresponding indicators set out by the global community, will depend on the South African health sector and other sectors increasing their focus on children's environmental health risk factors and exposures, as well as promoting social solidarity (Table 30 and Figure 54). Multi-sector collaboration will be needed to have effective interventions for achieving the SDGs.

Figure 53: Interventions to reduce children's environmental health exposures and risks

Table 29: Sustainable Development Goals promoting children's environmental health

Goal	Sector/environmental Impact
SDG 1 – No poverty	equity and nutrition
SDG 2 – Zero hunger	equity and nutrition
SDG 6 – Clean water and sanitation	water, sanitation and hygiene (WASH) and chemical exposures
SDG 7 – Affordable and clean energy	energy, air pollution and climate change
SDG 8 – Decent work and economic growth	infrastructure and settings
SDG 9 – Industry, innovation and infrastructure	infrastructure and settings
SDG 10 – Reduced inequalities	equity and nutrition
SDG 11 – Sustainable cities and communities	infrastructure and settings
SDG 12 – Responsible consumption and production	chemical exposures
SDG 13 – Climate action	energy, air pollution and climate change

Figure 54: Reducing harmful environmental exposures by achieving the SDGs



Source: World Health Organization (2017) *Inheriting a Sustainable World? Atlas on children's health and the environment.* Geneva: WHO.
Licence: CC BY-NC-SA 3.0 IGO.

Expand and improve health systems and infrastructure linked to environmental health

In South Africa, the scope of environmental health and associated legislation is linked to the services of environmental health practitioners (EHPs) working at the municipal level. While these services are invaluable, their scope needs to be expanded to support the extensive workload of EHPs as well as to bring in other role-players at national level and beyond the health sector.

Many conditions linked to environmental exposures are notifiable medical conditions in South Africa (e.g. pesticide poisoning, lead poisoning, food poisoning, plague, cholera) which EHPs are tasked with following up for prevention. However, EHPs need regular training of EHPs on emerging issues such as street pesticides, EDCs and climate change are missing. Furthermore, the surveillance data collected by EHPs are not reaching policymakers in health, agriculture and the environmental sector. EHPs are also a crucial link in climate change surveillance data (e.g. the increase of scabies cases linked to the drought in Cape Town), but no system is currently in place to collect this valuable information.

The health system in South Africa needs to strengthen capacity and infrastructure for managing the increase of NCDs and EWE impacting on health. National Health Insurance (NHI) could play a key role in achieving these

Table 30: Summary of key legislation and policies linked to the four key environmental hazards

	Key policy and legislative measures to protect children from environmental exposures
Air pollution	**Environmental Management Air Quality Act**[48] • Focuses on outdoor/ambient air pollution, yet no specific mention is made of children. • No criteria for "acceptable exposure risks" for children. • Does not cover indoor air quality despite indoor pollution in South African households exceeding WHO guidelines. • Further legislation is needed to protect specifically children under five who are vulnerable to respiratory infections linked to indoor air pollution.
	National Framework for Air Quality Management[49] • Provides some child-specific text (e.g., health messages to be communicated). • Implementation of the framework for children is an issue.
	Strategy to Address Air Pollution in Dense Low-Income Settlements[50] • Acknowledges exposure risks for children. • Focuses on awareness raising and changing the mindset of youth and school-going children. • Not clear that the recommended strategies will protect and reduce child exposure or whether this strategy will be implemented.
Chemicals	**Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act**[51] • The Act is outdated and should be amended to include safety factors or specific risk assessment data to protect children in all life stages.
	Pesticide Management Policy (2010)[52] • Highlights the need to repeal or revise the Act and introduce special protection for vulnerable populations such as children. To date, this has not occurred. • The policy includes no other provisions for children.
	Chemicals Management Bill • There is no legislation for chemicals in products because the Bill was withdrawn due to industry pressure. • There is a need for a 'Child Safe Products Act' which specifically controls, monitors and requires testing and labelling of chemicals in products used by and for children.
	Hazardous Substance Act[53] • Lists lead in paint as a hazardous substance but lacks the monitoring of results in continued sales and children's exposure. • Environmental health practitioners could play a stronger role in enforcing legislation. • 2019 draft regulations propose a total lead limit of 90ppm for children's products (intended for children < 12 years old).
Water pollution, sanitation and hygiene	**The Water Services Act**[54] **and the Strategic Framework for Water Services**[55] • Both deal with the provision of potable water and sanitation services. • The Act stipulates that everyone has a right of access to basic water and sanitation; but do not necessarily single out children, except a mention of vulnerable groups such as households headed by women or children or affected by HIV/AIDS. No further details are provided. • The strategic framework allocates responsibility to the Department of Basic Education for the provision of WASH facilities in schools, and the Department of Health for the provision of WASH facilities in health-care facilities. **The National Sanitation Policy**[56] • Endorses the national sanitation targets and the 2015 SDGs for achieving universal access to adequate and equitable sanitation and hygiene by 2030. • Includes sections on gender, youth and those with disabilities; and crèches, day-care centres, schools and clinics are included under institutional sanitation services; but there is little that specifically addresses the needs of children, particularly the most vulnerable. • Recognises the need to provide appropriate technology for children, and ensure the safety of women and girls, but neither recognises their particular vulnerability nor prioritises their needs in disaster settings or the provision of free basic sanitation. • Action is required to translate the policy into practice, to address the critical sanitation needs, and address the gaps in the policy focus. **Minimum Norms and Standards for School Infrastructure**[57] • Provide the first legally binding framework for the provision of school infrastructure including specifications for water, toilets, electricity and classroom size – and clear deadlines for implementation.

	Key policy and legislative measures to protect children from environmental exposures
Climate Change	**Climate Change Bill**[58] Second draft currently under review. No specific reference to the health of children or children in general. Fails to speak specifically to the health impacts of future generations or to children in relation to climate-sensitive NCDs.
	Draft National Climate Change Adaptation Strategy[59] • Currently under review. • No specific reference to the health of children or children in general. • Mentions the vulnerability of the poor to EWE; but does not refer to children specifically and particularly in relation to the mental health impacts from EWE. • It is therefore recommended that the following text is added to the draft for children's best interests in relation to sections 24 and 28 of the Constitution: • *The NCCAS recognises that children are particularly vulnerable to climate shocks and stresses, since they are still developing, and will ensure that all policies and implementation strategies prioritise the protection of children from exposure to risk/harm. Ensure climate change and prevention strategies and "citizen science" are included in primary and secondary school curricula.*
	National Climate Change and Health Adaptation Plan 2020 – 2024[60] • First draft has been circulated by the national Department of Health. • "Young children" are listed under vulnerable groups, but no mention of unborn children or adolescents. Child-centred measures and indicators are missing.
	National Development Plan 2030[61] • Refers to children as vulnerable to the effects of climate change but no specific details other than this statement. • Mentions urban development plans should address "concerns of children and youth and reflect their voice". • Limited reference to mental health but not in relation to extreme weather events.

goals. Increasing health professionals' knowledge base to diagnose, treat and prevent diseases and injuries linked to environmental factors is a crucial first step.

Secondly, health institutions need to be climate resilient to withstand the impact of EWE. A child-centred, resilient environmental health system that is adept at responding to children's specific exposures and windows of vulnerability across the life course, from conception to adolescence, needs to be established. The NHI is also fundamental in building social solidarity which will make South Africa more resilient to the impacts of climate change. Finally, policies promoting prevention – including safe alternatives – must be mainstreamed in the health system.

Strengthen the science-policy interface

The impact of environmental factors on child and adolescent health in South Africa has been overlooked by policymakers, health professionals and government officials who are not aware of the risks and challenges. Therefore, there is an urgent need to:

- Improve research translation and policymakers' access to environmental health research:[vi]
- Draw on data and legislation from other countries to protect children from environmental health risks, for example, by adopting a precautionary approach to legislation and banning harmful chemicals, products or production practices.
- Increase funding for local scholarly research on health impacts and prevention measures.
- Institute mechanisms to capture EHP data for surveillance.
- Set up systems for "citizen science" to inform policymaking (Box 18).

Mandate the inclusion of environmental health in training of health professional

Currently, students in medical and health professions in South Africa are not trained to identify, treat and prevent diseases linked to environmental exposures. Climate change will further increase children's exposures to mould and spores, causing respiratory problems. It is therefore vital that health professionals are taught how to conduct an environmental exposure history in order to identify and prevent further exposure. Health professionals are respected by a broad spectrum of the community and therefore serve as a vital link in health promotion and exposure prevention.

Empower children and adolescents to protect their health

It is important to include environmental health in primary and secondary school curricula to empower youth to protect themselves from environmental exposures. The curricula can include topics such as: how to read and comprehend labels; how to identify their environmental exposure risks; how to prevent or limit exposure; how to conduct citizen science; and how to advocate for environmental health and

i Academic and research institutions should include this as a requirement for ethics approval.

Box 17: The role of environmental health practitioners in South Africa

Environmental health practitioners (EHPs) are local government service providers employed by the Department of Health to work in all 228 municipalities.[62] There are an estimated 0.4 to 2.3 EHPs per 100,000 of the population.[63] EHP training is predominately conducted by universities of technology throughout South Africa and a large focus is on their inspectorate role. Once working for government and registered with the Health Professions Council of South Africa, EHPs enforce municipal by-laws to address a broad range of environmental health issues.

The National Health Insurance (NHI) Bill is silent on the role of some service providers such as EHPs. Given that this is a local government function delivered through municipalities, it is hoped that this service will receive NHI funding to continue the work by EHPs.

climate change rights. Children may not be able to vote, but through building their agency, they can have an impact on their health and environmental health especially in relation to third generation rights (i.e. unity rights as a universal citizen which include rights to self-determination, a healthy environment, sustainable development and the rights of future generations).[64]

All the interventions listed in Figure 53 should facilitate access to information and support the public, policymakers, health professionals and children's right to know, and right to comprehend, both the risks and prevention strategies.

How should progress of recommended interventions to promote child and adolescent environmental health be measured?

There are some efforts to address the health risks for children exposed to environmental factors in South Africa, but without monitoring and measuring progress we will continue to have gaps and limited action. To monitor the interventions in Figure 54 effectively, the following actions are needed:

- **Assess and prioritise** the environmental health risk factors in an area.
- **Sensitise** policymakers to environmental health issues and the implications for children's health.
- **Target** resources for research, surveillance and prevention with clear milestones and timeframes.
- **Encourage** action to improve the management of the environmental risk factors affecting children's health.
- **Highlight** the gaps in information and increase the knowledge base. It is ineffective to monitor and to measure progress, especially of indicators (Table 31), without sound and relevant data.

What are the key messages from this chapter?

The following are some key highlights and lessons from this chapter relevant for government, the private sector, and civil society.

Policy

The state needs to ensure that children's environmental health has a more prominent focus in policies and legislation across sectors. Child-centred indicators should be included in these policies to promote data collection, action and monitoring of outcomes which civil society should hold government accountable for. Monitoring of compliance with polices and legislation, as well as achieving targets is both the role of the state and civil society (e.g. NGOs, academia, child and adolescent activists).

Box 18: Citizen Science – A global movement for public participation

Citizen science is a means for members of the public, with no science background or even no formal education, to participate more actively in collecting information (knowledge production), knowledge assessment and policymaking. An example is the Equal Education sanitation audit where school children collected data on the state of WASH facilities in their schools. Through this citizen science, attention was raised to the problems and the government could be held accountable.

Technology is also aiding this movement by allowing the public to provide missing data, especially in relation to environmental health, through simple phone apps. People, including children, have access to rich data where they live, learn, work and play. By actively setting up this opportunity for children's environmental health in South Africa, researchers and policymakers would have a much better understanding of problem areas and where they are located to prioritise exposure prevention measures.

Source: Hecker S, Hakly M, Bowser A, Majuch Z, Vogel J, Bonn A (2018) Citizen Science – Innovation in Open Science, Society and Policy. London: University College London Press. Available to download free: www.ucl.ac.uk/ucl-press

Table 31: Sample indicators for monitoring risk-reduction interventions

Intervention	Example indicators for South Africa
Integrate children's environmental health in all policies (CEHiAP)	• Cross referencing of relevant health policies in non-health policies and legislation highlighting children.
Promote research evidence-based policies and programmes	• Standardised air pollution monitoring takes place daily in all provinces. • Air pollution data are distributed to regulators monthly to ensure compliance with regulations.
Strengthen health systems	• Morbidity rate due to specific environmental factors in children aged 0 – 4 years. • Number of EHPs trained in climate-sensitive NCD surveillance.
Ensure access to safe, sustainable and climate-resilient water and sanitation services	• Proportion of children with access to safely managed water services. • Proportion of water services which have been confirmed as being climate resilient. • Proportion of children with access to a basic sanitation service. • Proportion of schools which meet all three WHO/UNICEF Joint Monitoring Programme (JMP) standards for basic water, sanitation and hygiene facilities. • Proportion of health-care facilities which meet three of the five JMP basic standards (for water, sanitation, hygiene)
Improve education and training	• Number of doctors trained on diagnosis, treatment and prevention of environmental diseases and climate-sensitive diseases for children aged 0 – 15.
Promote children and caregivers' right-to-know and right-to-comprehend	• Chemical products labelled with standardised warnings. • Inclusion of standardised warnings and labelling in primary and secondary school curricula.

Industry

Underlying the environmental hazards and exposure risks for children is the extensive role of industry which has at times has lobbied government to remove bills and policies that could have reduced exposure, or resulted in watered-down and toothless policies. The state therefore has a responsibility to protect children's health by regulating toxic, polluting and otherwise harmful industries by implementing stringent regulations in line with international standards, as well as using the precautionary principle where health effects have limited attribution to the exposure. Civil society has a responsibility to highlight to the state through research, reports and activism the negative impacts industry is having on the environment and children's health. The industry has a responsibility to implement policies such as the "polluter pays" to clean up chemical, air and other pollution contamination impacting on children, as well as promote environmental and climate justice.

Communication

To reduce the current risks and health impacts from environmental factors on children and adolescent health, communication needs to be improved in multiple directions. For example, from researchers to policymakers and the public; from the public to EHPs for surveillance data. Mechanisms for ensuring this communication, as well as the right-to-know and right-to-comprehend are both the role of the state and civil society.

It is time that children's environmental health and linked burden of disease moved to the top of policy and research agendas so that environmental health is no longer an overlooked health risk. Strong leadership is needed to prioritise the strategies highlighted in this chapter to safeguard the health and well-being of children and adolescents. We need a healthy generation to lead and contribute to the future of South Africa.

References

1 Mandela NR (1995) Foreword. In: Whyte AV (ed) *Building a New South Africa. Volume 4: Environment, Reconstruction, and Development. Ottawa, ON: International Development* Research Centre.
2 World Health Organization (2017) *Inheriting a Sustainable World? Atlas on Children's Health and the Environment.* Geneva: WHO.
3 See no. 2 above. [World Health Organization (2017)]
4 Woods D, Aldous C, Christianson A & Malherbe HL (2016) The contribution of congenital disorders to child mortality in South Africa. *South African Health Review*, 2016(1): 137-152.
5 Tran NQV & Miyake K (2017) Neurodevelopmental disorders and environmental toxicants: Epigenetics as an underlying mechanism. *International Journal of Genomics*, 2017, article ID 7526592. https://doi.org/10.1155/2017/7526592;
Hobbs A & Ramsay M (2015) Epigenetics and the burden on noncommunicable disease: A paucity of research in Africa. *Epigenomics*, 7(4): 627-639.
6 Shezi B & Wright CY (2018) Household air pollution exposure and respiratory health outcomes: a narrative review update of the South African epidemiological evidence. *Clean Air Journal*, 28(1): 43-56.
7 World Health Organization (2017) *Don't Pollute my Future! The Impact of the environment on children's health.* No. WHO/FWC/IHE/17.01. Geneva: WHO.
8 Mathee A, Barnes B, Naidoo S, Swart A & Rother H-A (2018) Development for children's environmental health in South Africa: Past gains and future opportunities. *Development Southern Africa*, 35: 2: 283-293.
9 The Constitution of the Republic of South Africa, Act 108 of 1996.

10 See no. 9 above. Section 7 (2).
11 As declared by the World Health Organisation - https://www.who.int/airpollution/en/
12 Barratt A & Burman S (2001) Deciding the Best Interests of the Child: An International perspective on custody-decision making. *South African Law Journal*, 118: 556-573;
Skelton A (2013) The role of the courts in ensuring the right to a basic education in a democratic South Africa: A critical evaluation of recent education case law. *De Jure*, 1- 23;
Couzens M (2013) The Constitutional Court consolidates its child-focused jurisprudence: The case of C v Department of Health and Social Development, Gauteng. *South African Law Journal*, 130: 672-688.
13 *The Trustees for the Time Being of groundWork Trust and Others v The Minister of Environmental Affairs and Others.* The founding papers are available at: https://cer.org.za/wp-content/uploads/2019/06/DA-Court-Papers-final-version_unsigned.pdf.
14 See https://www.who.int/news-room/detail/29-10-2018-more-than-90-of-the-world%E2%80%99s-children-breathe-toxic-air-every-day; accessed 29 August 2019.
15 Gray HA (2019) *Air Quality Impacts and Health Effects due to Large Stationary Source Emissions in and around South Africa's Mpumalanga Highveld Priority Area (HPA).* Viewed 10 October 2019: https://cer.org.za/wp-content/uploads/2019/06/Andy-Gray-Report.pdf.
16 Bornman MS, Aneck-Hahn NH, De Jager C, Wagenaar GM, Bouwman H, Barnhoorn IEJ, Patrick SM, Vandenberg LN, Kortenkamp A, Blumberg B, Kimmins S, Jegou B, Auger J, DiGangi J & Heindel JJ (2017) Endocrine disruptors and health effects in Africa: a call to action. *Environmental Health Perspectives*, 25(8): 085005-1-085005-10. https://doi.org/10.1289/EHP1774
17 Masekela R, Green RJ, Manjra AI, Kritzinger FE, Levin M & Zar H (2018) The increasing burden of asthma in South African children: a call to action. *South African Medical Journal*, 108(7): 537-539.
18 Asher I & Pearce N (2014) Global burden of asthma among children. *International Journal of Tuberculosis and Lung Disease,* 18: 1269-1278.
19 Naidoo RN, Robins TG, Batterman S, Mentz G & Jack C (2013) Ambient pollution and respiratory outcomes among schoolchildren in Durban, South Africa. *South African Journal of Child Health*, 7(4): 127-134.
20 World Health Organization (2018) *Air Pollution and Child Health: Prescribing Clean Air.* WHO.
21 Landrigan PJ, Fuller R, Fisher S, Suk WA, Sly P, Chiles TC & Bose-O'Reilly S (2019) Pollution and children's health. *Science of the Total Environment*, 650: 2389-2394.
22 Naicker N, Mathee A & Barnes B (2013) Environmental lead: a public health challenge in South Africa. *Epidemiology,* 24(4): 621-622;
Mathee A, Singh E, Mogotsi M, Timothy G, Maduka B, Olivier J & Ing D (2009) Lead-based paint on playground equipment in public children's parks in Johannesburg, Tshwane and Ekurhuleni. *South African Medical Journal*, 99(11): 819- 821.
23 The court application and relevant information and material can be accessed at https://lifeaftercoal.org.za/about/deadly-air. See: Orris P (2019) Review of Dr. Andrew Gray's '*Air Quality Impacts and Health Effects due to Large Stationary Source Emissions in and around South Africa's Mpumalanga Highveld Priority Area (HPA)*'; and Annexure "SP34"- "SP36".
24 Landrigan PL & Landrigan MM (2018) *Children & Environmental Toxins – What everyone needs to know.* New York: Oxford University Press.
25 Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947.
26 Rother H-A (2016) Pesticide vendors in the informal sector: Trading health for income. *New Solutions: A Journal of Environmental and Occupational Health Policy,* 26(2): 241-252.
27 Rother H-A (2010) Falling through the regulatory cracks: Street selling of pesticides and poisoning among urban youth in South Africa. *International Journal of Occupational and Environmental Health*, 16(2):202-213.
28 Hazvinyeni L (2019) Have 'hundreds' of kids drowned in school pit latrines in South Africa? *Africa Check*, 25 January 2019. Viewed 23 October 2019: https://africacheck.org/reports/have-hundreds-of-kids-drowned-in-school-pit-latrines-in-south-africa/.
29 McFarlane R, Ford A & Bukenya A (2018) *Breaking the Cycle: Uncovering persistent sanitation challenges in Gauteng schools.* Johannesburg: Equal Education.
30 Department of Basic Education (2013) South African Schools Act, 1996 (Act No 84 of 1994): Regulations Relating to Minimum Uniform Norms and Standards for Public School Infrastructure. Notice R. 920, *Government Gazette* No 7081, 29 November 2013.
31 Adams J, Bartram J, Chartier Y & Sims J (2009) *Water, Sanitation and Hygiene Standards for Schools in Low-cost Settings.* Geneva: World Health Organisation.
32 See no. 30 above.
33 See no. 29 above.
34 See no. 30 above.
35 United Nations Committee on the Rights of Persons with Disabilities (2015) *Consideration of reports submitted by States parties under article 35 of the Convention. South Africa. CRPD/C/ZAF/1.* Geneva: UNCRPD.
36 Joint Monitoring Programme (2019) Estimates on water, sanitation, hygiene, health care waste services and environmental cleaning in health care facilities in South Africa. WHO/UNICEF. Viewed 12 October 2019: https://washdata.org/monitoring/schools/country-files-2018
37 Chersich MF, Wright CY, Venter F, Rees H, Scorgie F & Erasmus B (2018) Impacts of Climate Change on Health and Wellbeing in South Africa. *International Journal of Environmental Research and Public Health*, 15(9): 1884.
38 Wright CY, Norval M & Albers PN (2015) Climate change, public health and COP21 – a South African perspective. *South African Medical Journal*, 105(12): 997-998.
39 Mares D (2011) Climate change and levels of violence in socially isadvantaged neighbourhood groups. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 90(4): 768-783.
40 Department of Environmental Affairs (2019) Draft National Climate Change Adaptation Strategy. Notice 644, *Government Gazette* No. 42446, 6 May 2019.
41 Department of Health (2019) *National Climate Change and Health Adaptation Plan 2020-2024.* First review version. Pretoria: DoH.
42 Department of Environmental Affairs (2018) Climate Change Bill. Notice 580, *Government Gazette* No. 41689, 8 June 2018.
43 World Health Organization (2019) *Snakebite Envenoming – A Strategy for Prevention and Control.* Geneva: WHO.
44 Garland RM & Rother H-A (2017) Vulnerability of human health sector to climate change. In: Davis-Reddy CL & Vincent K (eds). *Climate Risk and Vulnerability: A handbook for Southern Africa.* 2nd edition. Pretoria: Council for Scientific and Industrial Research.
45 Frumkin H, Hess J, Luber G, Malilay J & McGeehin M (2008) Climate change: The public health response. *American Journal of Public Health,* 98: 435-445.
46 The Global Coordination Group of the Youth-led Climate Strike (2019) Climate crisis and a betrayed generation. *The Guardian*, 1 March 2019: https://www.theguardian.com/environment/2019/mar/01/youth-climate-change-strikers-open-letter-to-world-leaders.
47 UNICEF (2019) *16 children, including Greta Thunberg, file landmark complaint to the United Nations Committee on the Rights of the Child. Child petitioners protest lack of government action on climate crisis. Press release. 23 September 2019. Viewed 12 October 2019: https://www.unicef.org/turkey/en/press-releases/16-children-including-greta-thunberg-file-landmark-complaint-united-nations*
48 Department of Environmental Affairs (2005) National Environmental Managament: Air Quality Act 39 of 2004. Notice 163, *Government Gazette* No. 27318, 24 February 2005.
49 Department of Environmental Affairs (2018) National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). The 2017 National Framework for Air Quality Management in the Republic of South Africa. Notice 1144, *Government Gazette* No. 41996, 26 October 2018.
50 Department of Environmental Affairs (2019) National Environmental Management: Air Quality Act (Act No. 39 of 2004). Strategy to ddress Air Pollution in Dense Low-income Settlements. Notice 666, *Government Gazette* No. 42464, 17 May 2019.
51 See no. 25 above.
52 Department of Agriculture, Forestry and Fisheries (2010) Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947). Adoption of Pesticide Management Policy for South Africa. Notice 1120, *Governemnt Gazette* No. 33899, 24 December 2019.
53 Department of the Prime Minister (1973) Hazardous Substances Act 15 of 1973. Notice 550, *Government Gazette* No. 3834, 4 April 1973.
54 Water Services Act 108 of 1997.
55 Department of Water Affairs and Forestry (2003) *Strategic Framework for Water Services (September 2003).* Pretoria: DWAF.
56 Department of Water and Sanitation (2016) *National Sanitation Policy.* Pretoria: DWS.
57 See no. 30 above.
58 See no. 42 above.
59 See no. 40 above.
60 See no. 41 above.
61 National Planning Commission (2012) *National Development Plan.* Vision 2030. Pretoria: NPC.
62 Shezi M, Mathee A, Siziba W, Street RA, Naicker N, Kunene Z & Wright CY (2019) Environmental health practitioners potentially play a key role in helping communities adapt to climate change. *BMC Public Health*, 19: 54.
63 Gray A & Vawda Y (2017) Health policy and legislation. In: Padarath A & Barron P (eds) *South African Health Review 2017.* Durban: Health Systems Trust.
64 Chersich MF, Scorgie F, Wright CY, Mullick S, Matthee A, Hess J, Richter M & Rees H (2019) Climate change and adolescents in South Africa: The role of youth activism and the health sector in safeguarding adolescents' health and education. *South African Medical Journal*, 109(9): 615-619.