LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Climate Change & Planetary Health

Children, Cities and Climate

It's time to listen to young people and cut carbon, clear the air and improve health

Preliminary findings from a global survey of urban young people on the air they breathe and a child health co-benefits analysis of radical decarbonisation of 16 global cities.

“Engage the young people to be in the front”

“Make the whole city a classroom for children”

“We as a society will come together to deal with the problem”

Phase 1: Research Report, October 2021

Preliminary results of a new LSHTM initiative exploring the intersection of cities, climate and children and young people.

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Acknowledgements

We would like to acknowledge the financial support from Fondation Botnar for this research, and from Facebook Inc for advertisement credit to support social media recruitment of survey respondents. In addition, we have appreciated the air pollution modelling data that has been shared by Jos Lelieveld and Sourangsu Chowdhury at the Max Planck Institute for Chemistry, and the extremely helpful advice and information on exposure-response functions and neonatal outcomes from Rakesh Ghosh at University of California San Francisco.

fondation BOTNAR

Image credit: Dhiya Vignesh – unsplash.com

Executive Summary

It is increasingly well understood that climate breakdown threatens catastrophically to undermine health globally[1]. The inter-generational injustice that today's leaders are bestowing a heating planet onto future generations is attracting global attention[2] and inspiring young people to sound the alarm in cities across the world[3].

While the harms of inaction become clearer every day, few have explored whether decarbonisation could be good for public health, and especially that of children. Moreover, limited attempts have been made to ask young people (and parents) what they think about their environments and the air they breathe. This new study is seeking to answer three interconnected questions:

- What is known about how rapid decarbonisation could affect maternal, newborn, child and adolescent health?
- Looking specifically at air pollution, and how a transition to 'net-zero' would improve air quality, how might maternal and child health be improved by this shift?
- What do children, young people and parents think about their cities, and the quality of the air they breathe?

These questions have been tackled through a combination of the following methods:

- **Literature reviews**, including a systematic review of the literature on the potential benefits to child health of decarbonisation.
- **Co-benefits modelling**, to model how reaching 'net-zero' might affect maternal, newborn, and young people's health across 16 cities around the world.
- **A global survey of over 3,000 young people and parents from 59 cities**, aiming to understand perspectives on their cities, urban air pollution, and ideas for how these can be improved.

There are two clear **recommendations** that are emerging from this ongoing research initiative:

1. **The benefits to the health of children and young people from radical decarbonisation are likely to be large, and these need to be better examined, and more well understood**; they must become an important consideration in critical climate, environmental and health policy debates.
2. **The views of young people must be central in conversations about urban development and decarbonisation at both the city and global level**; they have vital perspectives and powerful ideas.

These findings provide further evidence to support ambitious and urgent collective action to reduce reliance of fossil fuels in and around our cities.

Five emerging headlines from the research

1. **Improving urban air quality quantifiably improves maternal/child health in numerous important ways**: we identified at least five health outcomes in children that would be improved by better air quality. Specifically, these were: asthma (incidence and severity), lung growth, respiratory infections, birth outcomes (specifically being born too small or too soon), and cognitive development and learning.
2. **Child health gains from a transition to 'net-zero' are likely to be large**. Specifically, we estimate that, across just 16 cities*, each year:
   - More than 20,000 new cases of asthma could be prevented
   - More than 43,000 premature births, and more than 22,000 low-birthweight births could be avoided
3. **Young people living in cities seem to understand this; they see air pollution as one of the worst things about their city** – 4 in 10 reported that it was one of the worst things about their city. Only traffic was more frequently cited as a bad thing about where they live.
4. **Young people have a wealth of creative and ambitious ideas for how their cities could be improved, both in general, and in terms of the air pollution**. These include specific ideas like better public transport and space for walking and cycling alongside the need to challenge underlying problems like inequality, bad governance and the lack of ways young people can engage in decision making.
5. **Little research has been conducted** at the nexus of cities, climate and children/young people; we are not aware of any other large-scale efforts to ask young people themselves what they think of these issues, and to solicit their ideas.

* The cities we have conducted this analysis for are: Bhubaneswar, Dar es Salaam, Dhaka, Freetown, Glasgow, Harare, Jaipur, Lahore, London, Los Angeles, Manila, Mexico City, Milan, Nairobi, Quito and Tamale.

Background

The nexus of climate change, cities and child health is critical for the future of people and the planet.

Across the world, **children are likely to be among those worst affected by climate change**. A child born today will live in a world four degrees warmer than the pre-industrial average[4]. 93% of the world's children breathe polluted air[5]; food systems are increasingly unable to deliver the healthy diets needed for childhood growth; and by 2040, 25% of the world's children will experience extremely limited water resources as a result of climate change[4].

The world is urbanising fast, and of the 4 billion people living in cities today, children represent over 30%, and this will rise to 70% of 6.7 billion urban dwellers by 2050[6]. The energy and resource requirements of cities are also a major driver of the climate crisis, being responsible for an estimated 70% of global carbon emissions[7].

There is a growing body of research evidence into how drivers of climate change such as the burning of fossil fuels affect children and young people through the effects of toxic air pollution[(8)]. In contrast very little research has explored whether the **decarbonisation of economies will impact on the health of children and young people**.

In addition, there have been **few attempts to explore and understand the views and ideas of young people themselves about their cities**, and the air they breathe.

Through this work, we have attempted to address these critical gaps through a 6-month mixed methods research sprint, which has included:

1. A pair of **literature reviews** that:
   - identify where there is strong evidence connecting air pollution to maternal and child health outcomes; and
   - systematically review existing studies exploring the potential health co-benefits for children and young people of carbon emission reduction.
2. A **health and climate co-benefits modelling study**, through which the impacts of a radical decarbonisation on air quality across 16 cities have been estimated, initially looking at three key health outcomes.
3. A **global survey of over three thousand young people** across more than 50 cities to explore their perspectives on the cities they live in and how they can be improved.

The overall aim of this work is to generate knowledge and resources to inform decisions about decarbonisation to enable children to live healthily and sustainably in the future.

Research questions

Literature reviews	Co-benefits analysis	Global youth survey
What is the magnitude of the health gains resulting from the reduction of outdoor and indoor air pollution in children and young people? What are the health effects of actions and policies aimed at mitigating climate change in children and adolescents?	Which health outcomes in children and young people have been associated with exposure to air pollution, and for which outcomes is there sufficiently robust evidence to allow quantification of health impacts? What is the magnitude of air pollution reductions that could be achieved through ambitious climate change mitigation actions in 10 cities, and what would be the resulting impact on the health of children and young people?	How do children, young people and parents (CYPP) feel about their cities? Specifically, what features of their urban environment do they like, and what do they dislike, and do they feel it is becoming a better or a worse place to live. What are the perceptions of CYPP who live in cities of air quality where they live, study and work? What do they perceive are the main sources of air pollution affecting them? What are CYPP's priorities for improving their urban environment?

Methods

1. Literature reviews

Two reviews have been undertaken. Both reviews specifically looked for papers published in English that reported health outcomes in people aged less than 18 years.

1. To identify child health outcomes that could quantifiably be affected by air quality; (to use in the co-benefits analysis). This review sought to identify systematic reviews and metanalyses reporting associations between changes in health outcomes and changes in pollutant levels. Examples of search terms indicating exposure to air pollutants included fossil fuel, PM2.5, nitrogen dioxide, greenhouse gasses, smog, particulate matter, air quality.

2. To systematically review the global evidence on the potential co-benefits for maternal, newborn, child and adolescent health that could arise from reducing the release of carbon dioxide and other greenhouse gases in the air. The systematic review methods were published in advance of search for papers on the PROSPERO register (protocol number CRD42021271717). We systematically searched the following databases: OvidSP MEDLINE, OvidSP PubMed, OvidSP EMBASE, Global Health, Scopus, and ISI Web of Science, from 1 January 1990 until July 2021. Example of search terms used for interventions to reduce air pollutants were mitigation, renewable, sustainable, climate change, energy efficiency. The search strategy was not restricted to specific health outcomes. The full search strategy with all search terms used will be included in the published review.

2. Co-benefits analysis

The research team modelled the health benefits of decarbonisation across 16 global cities by estimating the burdens of various health outcomes in children caused by air pollution at current levels, and for levels corresponding to a global net-zero scenario. The pollutants considered were fine particulate matter (PM2.5) and nitrogen dioxide (NO_2), both of which have established links to health in children and adolescents. The researchers estimated how a global transition to net-zero would affect concentrations of these pollutants in the 16 cities. The simplified assumptions that were used are in box 1 below.

Box 1: Assumptions made to generate 'net-zero' scenario

- Net-zero was assumed to involve the removal of all PM2.5 and NO_2 emissions from the following sectors: energy generation, industry, domestic energy use and land transport.
- We assumed removal of global emissions from these four sectors.
- Only direct exhaust (combustion) emissions were removed.
- Average air pollution concentrations (present and net-zero) for each city were estimated as the population weighted average of concentration estimates at 1x1 km resolution within the city boundaries.

Based on these assumptions, a proportion of current air pollution levels was removed to simulate net-zero in each city. For PM2.5 the reductions ranged from 8% (Freetown) to 64% (Dhaka). For NO_2 the reductions were from 8% (Freetown) to 92% (Mexico City).

The child health benefits were modelled in terms of numbers of new asthma cases (from reduced NO_2) and numbers of premature births and births with low birthweight (from reduced PM2.5). For asthma, the exposure-response function (ERF) was taken from Khreis et al.[9] and, for birth outcomes, the ERFs were from Ghosh et al.[10]; these were judged to be the highest quality current published reviews available which covered the range of exposure levels being modelled.

3. Youth survey

Data for the youth survey study were collected through a short anonymous multi-language* online survey that was completed by eligible respondents (see Box 2) who were recruited through promoted social media adverts (on Facebook and Instagram) targeted at young people and parents in 16 global cities. The survey was available in 10 languages.

Survey questions explored:

- Basic demographics - age, sex, and if they were currently pregnant (only if aged >18 if they are a parent or not, of if expecting).
- Perceptions about their city – positive and negative features.
- Perceptions about air pollution in their city – overall quality of air they breathe, key sources.
- Thoughts about if their urban environment is improving, or deteriorating, opportunities for improvement in generally, and specifically to tackle air pollution.

Box 2: Survey eligibility

Social media recruitment advertisements were targeted to reach the following groups:

- Young people aged between 13 and 25 years (13 years is the age when children are allowed to open a social media account in almost all countries).
- Parents of children aged <13 years.
- Expectant parents.

In addition, initial survey questions checked eligibility of respondents, also enabling analysis by sub-group of respondents.

Survey recruitment advertisements were designed to appeal to all young people living in their city (rather than those particularly concerned about the environment). The algorithm controlling the placement of recruitment advertisements was set to optimise to initial clicks rather than survey completion (to reduce the risk of selection bias in recruitment). The survey instrument was pre-tested in two phases including by members of the research team and advisers including youth representatives from Shujaaz[11] and y-labs[12]. The survey instrument was hosted by Typeform[13].

The data were analysed by city and quartiles of city pollution level (based on WHO data on annual average levels of pollution, the cities were divided up into four groups). Responses to closed (quantitative) responses were summarised. Open-ended responses were coded to identify common themes and ideas from within and across all cities.

*The survey (including consent form and FAQs) was available in the following languages: English, Spanish, French, Kiswahili/ Sheng, Hindi, Urdu, Italian, Bengali, Arabic, Mandarin Chinese.

Key findings

Literature reviews

Five key important sets of health outcomes were identified for which high-quality systematic review evidence is available to quantifiably connect changes in air pollution to child health outcomes.

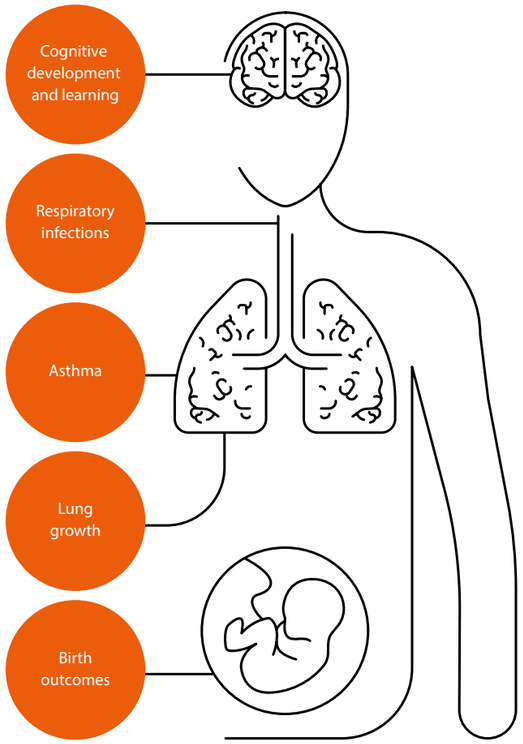
These outcomes are:

1. Cognitive development and learning;
2. Respiratory infections including pneumonia;
3. Asthma incidence and asthma severity;
4. Lung growth; and
5. Birth outcomes (specifically being born prematurely or at low birth weight).

The systematic review of published child co-benefits analyses is underway and will be completed shortly. After screening more that 23,000 titles and abstracts of papers published in scientific journals, we have found fewer than 50 papers published in English in peer reviewed journals reporting results on health outcomes in people under 18 years of age that may be relevant for inclusion in the final review.

Our preliminary review shows that most identified papers reported on respiratory benefits deriving from cleaner air, such as reduction of cases of asthma or bronchitis, including hospital admissions. Some papers reported on improvements of foetal health, or the avoidance of premature deaths among children.

This is still a work in progress, and we will conduct a detailed analysis of the findings reported in papers potentially included in the review and summarise them by health outcome and intervention.



Child and maternal health outcomes that improve with cleaner air

Co-benefits analysis

The modelling analyses have so far estimated that if global air pollution levels were reduced by actions to achieve net-zero:

- more than 20,000 cases of childhood asthma;
- over 43,000 premature births; and
- over 22,000 low birthweight births could be averted annually across the 16 cities in total.

This represents almost a quarter of the current number of asthma cases in these cities and a reduction of about 10% for adverse birth outcomes.

At a city level, the results showed:

- Los Angeles, Mexico City, and Manila would see the greatest reduction in childhood asthma annually, with 7,200, 5,700 and 4,000 new cases averted respectively.
- 1,700 fewer new asthma cases would occur in London annually, the third highest number after Los Angeles and Mexico City, when considered in relation to population density (cases averted per 100,000 of the population).
- Dhaka, Manila and Lahore would see the greatest reduction in premature births annually, with 23,800, 7,000 and 4,600 cases prevented respectively. The same cities would see the largest benefits with regard to low birthweight births, with 13,500, 2,500 and 3,100 cases averted.
- Dhaka, Bhubaneswar and Jaipur would see the greatest reductions in adverse birth outcomes, when considered in relation to the number of births each year (cases averted per 100,000 births).

Table 1: Annual estimated total new asthma cases, preterm and low-birthweight births averted in one year from a 'net-zero' scenario.

City	Total cases averted in one year		
	Asthma	Preterm birth	Low birthweight
Bhubaneswar	13	540	270
Dar es Salaam	75	189	60
Dhaka	332	23,889	13,514
Freetown	1	20	8
Glasgow	110	69	22
Harare	9	71	23
Jaipur	44	905	488
Lahore	315	4,643	3,167
London	1,791	813	262
Los Angeles	7,210	939	287
Mexico City	5,755	3,581	1,521
Manila	4,068	7,044	2,513
Milan	331	266	95
Nairobi	287	274	86
Quito	320	157	70
Tamale	1	16	7

Table 2: Annual estimated new asthma cases, preterm and low-birthweight births averted in one year from a 'net-zero' scenario per 100,000 population.

City	Cases averted in one year per 100,000		
	Asthma (per 100,000 population aged 19 and under)	Preterm birth (per 100,000 births)	Low birthweight (per 100,000 births)
Bhubaneswar	6	6,385	3,194
Dar es Salaam	6	274	86
Dhaka	5	6,306	3,568
Freetown	1	342	133
Glasgow	35	458	145
Harare	3	394	130
Jaipur	7	3,556	1,918
Lahore	7	1,816	1,239
London	66	618	199
Los Angeles	159	477	146
Mexico City	44	1,762	629
Manila	67	873	371
Milan	43	821	295
Nairobi	20	370	116
Quito	42	395	175
Tamale	3	600	270

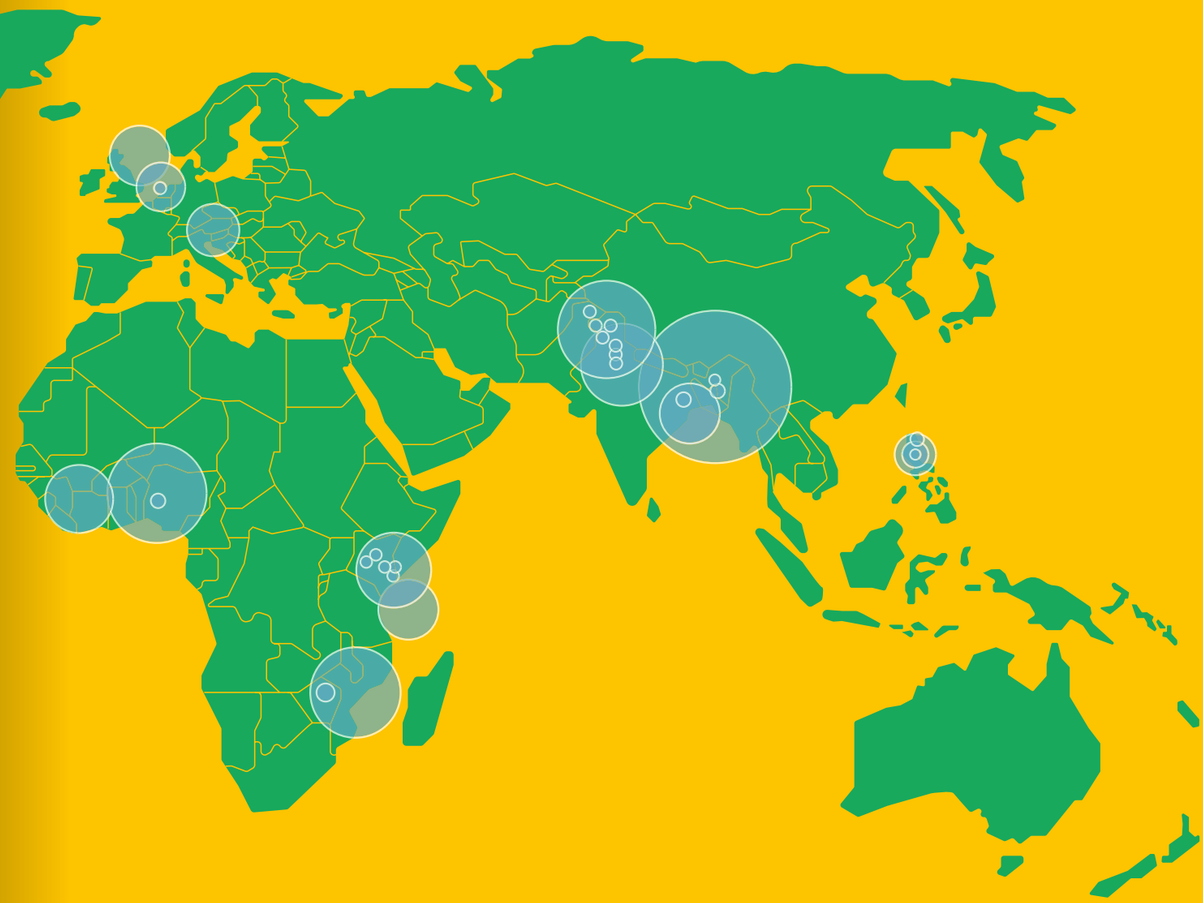
Youth survey

Of the 49,329 people who viewed the survey "landing page", 3,222 young people (aged 13-25), parents of younger children and expectant parents from 59 cities around the world completed the survey. 75% (2,430) of these were young people aged 13-25, and 25% were parents of children aged under 13 (509, 16%) or expectant parents (283, 9%). 97% of survey responses were in one of five languages; English, Bangla, Spanish, Hindi or Urdu. 94% of respondents were from cities in the 3rd or 4th most polluted quartiles for annual average PM2.5 exposure levels (based on WHO figures[14]).

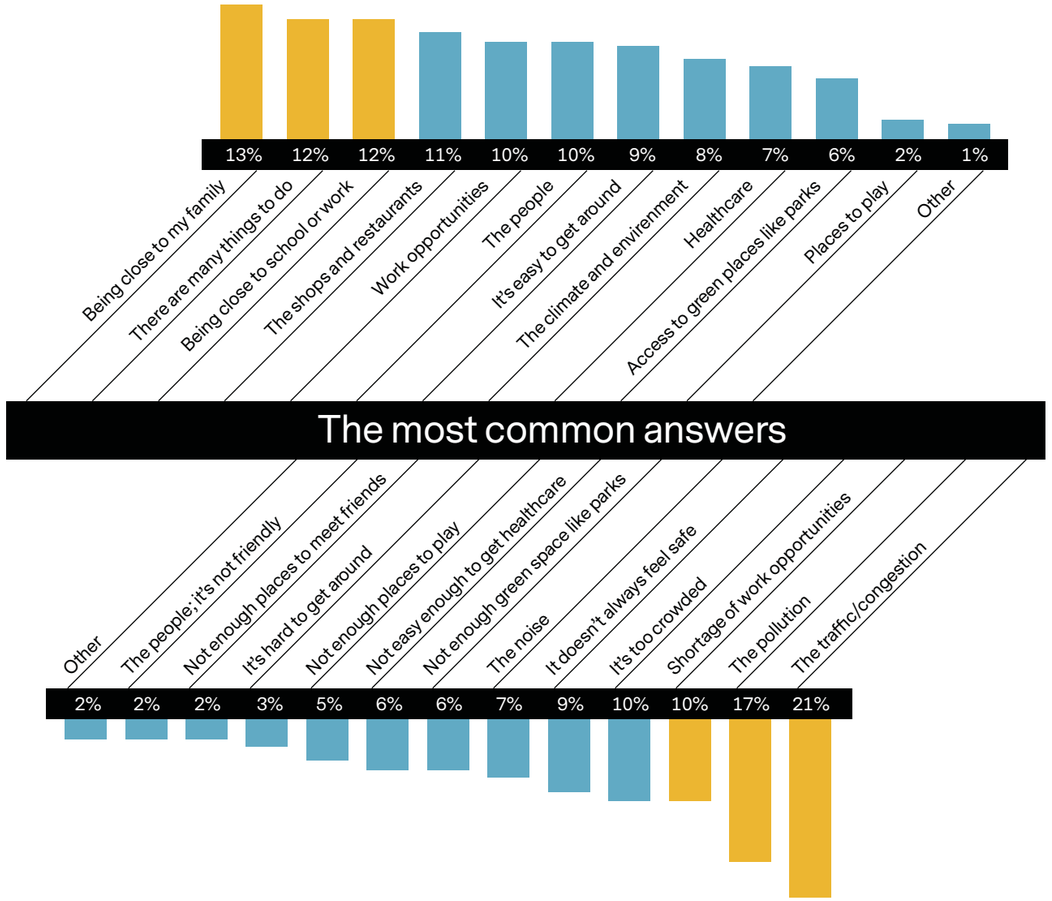
Key findings included:

- **Four in ten respondents identified air pollution as one of the three worst things about their city, second only to traffic and congestion.**
- **Young people blamed motor transport, factories, rubbish burning and construction for the air pollution in their city.**
- **Four in ten respondents said that their city was becoming a nicer place to live, while a third said it was getting worse.**

Frequency of respondents from 59 Global Cities.



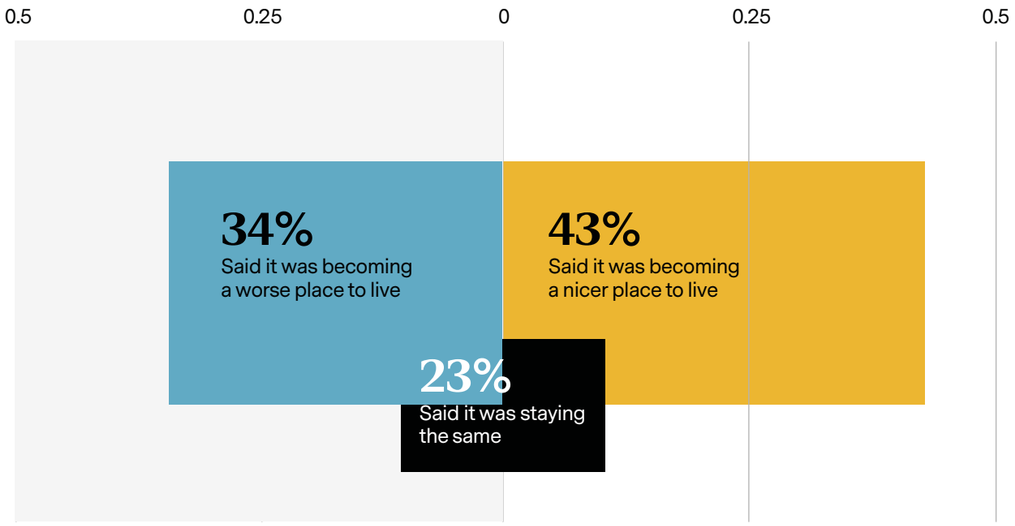
The 'best' thing about your city...



The most common answers

...the 'worst' thing about your city

We asked 2,993 young people how their cities were changing.



Free-text responses to questions about how to improve cities were extensive and varied. Participants shared a combination of:

1. **Guiding principles for how to improve cities** for young people, for example the need to be ambitious and creative, and how important it is to meaningfully engage with young people in this process.

"I would make the wholecity a classroom for the children".

"Engage the young people to be in the front".

"Our leaders have to consider the opinions of the youth in order to facilitate development in our country".

"I really hope the government will embrace the opinions from us, the youth in terms of our social status and rights. At this point we still haven't had a chance to fully show who we really are to the community and the world at large".

2. Highlighting **structural barriers that need to be addressed** to improve urban health, including underlying inequality, weak governance/corruption, and lack of climate/environment consciousness.

"Easy living for rich people, hard for poor or middle class families".

"If you don't have money you'll die because they won't attend to you".

"Corruption is the root of all these problems. None can solve these issues without solving corruption".

"Educating the populace about the harmful effects of air pollution so they can find means where by we as a society will come together to deal with the problem at hand".

3. **Specific suggestions for improvements** to city design, urban mobility, health, education basic services and job opportunities.

"There is no other way than planting more trees".

"Creating a massive, comfortable, fast and efficient transportation system".

"Giving incentives to change old and polluting boilers as well as incentives to change cars too polluting".

"Sort out the buses".

"We could give free vouchers for buses with would encourage them to be used more often and rewards for do so. e.g, free underground transport for a day".

Nevertheless, **others felt unequipped to solve these complicated urban health problems**, pointing out that they were reliant on those in power:

"Please if you see this try and help this country. We are suffering".

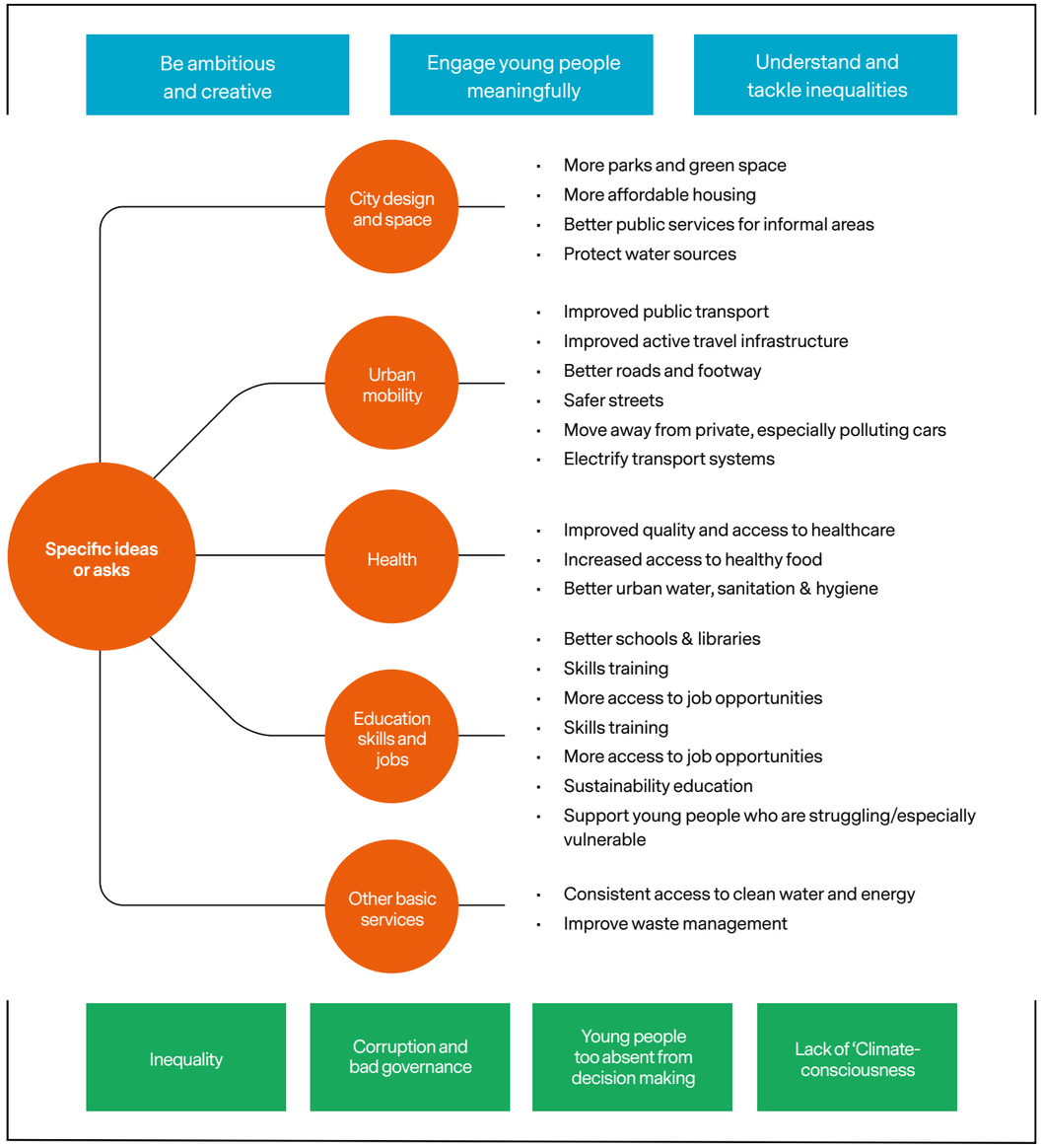
"Too much to think about at this hour of the day".

"…positive measures should be taken in order to rectify these problems. I really appreciate you all because "we" as the people living in this country have nowhere to cry for justice. We are just going harder and harder day by day".

"DNT KNW".

"Nah, its too sad and if I think about it too much it pisses me off".

Guiding principles for how to act



Structural barriers that need to be addressed

Recommendations and next steps

There are two clear recommendations that are emerging from this ongoing research initiative:

1. **The benefits to the health of children and young people from radical decarbonisation are likely to be large, and these need to be better examined, and more well understood**; they must become an important consideration in critical climate, environmental and health policy debates.

1. **The views of young people must be central in conversations about urban development and decarbonisation at both the city and global level**; they have vital perspectives and powerful ideas.

Through a comprehensive set of public engagement activities we are sharing these findings with a broad constituency, ranging from children and young people themselves to policy makers and other academics.

Next steps:

The next steps for completion of this work include:

- Completion of the co-benefits analyses, to include further child health outcomes.

- Publication of these studies and the systemic review in peer reviewed journals.

Additionally, we are currently designing a second phase of the CCC project, which will both expand and deepen the coverage of the surveys and co-benefits analyses reported here and will explore young peoples' views about - and the potential co-benefits of other types of urban climate change mitigation action, for example the impacts of changes in urban mobility, diet or heat.

If you are interested in collaborating, supporting or following this work, please get in touch at **ccc@lshtm.ac.uk** and follow us **@lshtm @lshtm_planet**

Public engagement and research uptake linked to this work

Youth engagement has been a central element of the research project, which was designed to involve young people from the outset, enable them to be spokespeople for the findings and elevate their voices to influence policy.

Youth advisors were consulted to ensure survey questions were appropriate, inclusive and relevant to a wide range of young people living in cities around the world. Briefings and ongoing conversations between the research team and representatives of various youth organisations has allowed for deep engagement that can be carried forward into future phases of the study.

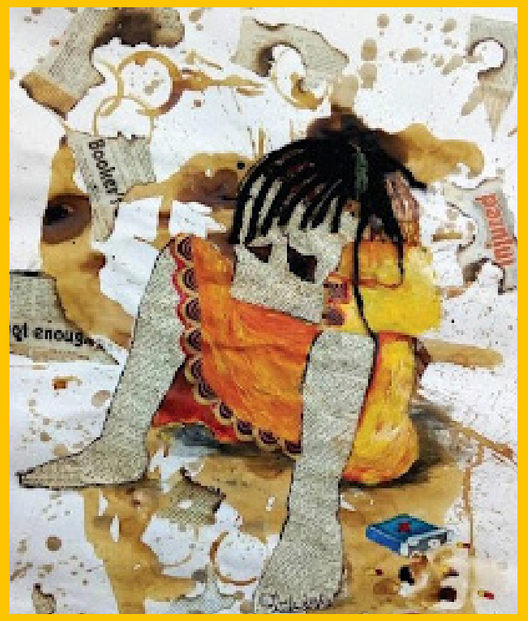
Early research findings were shared through an event held as part of the All4Climate - Italy 2021 series, taking place alongside the pre-COP and Youth4Climate summits in Milan. The event was interactive and youth-led, featuring speakers from YOUNGO, Fridays For Future, IFMSA, amongst others. In addition to this, workshops, discussion groups and social media campaigns have been carried out.

The project is also encouraging young people to engage creatively with the topic, for example through an art, design and music competition in Zimbabwe on the theme "The air we breathe in Zimbabwe's cities" and through contributions to a youth voices video project.

The results included in this report will be released at COY16 in Glasgow and have helped inform the youth statement that will be presented to world leaders at COP26. The findings and outputs from the public engagement activities will also be presented at COP26, with the aim of mobilising more young people to engage with the critical intersection of climate change, cities and child health and influencing effective policy making in this area.

Above: Art of Health Breathe In competition winner, Collin Makoni.

Right: Art of Health Breathe In competition, 3rd place, Busani Ncube.



Above: Jon Bonifacio, Education Coordinator, Youth Advocates for Climate Action Philippines, speaking at the Children, Cities and Climate All4Climate - Italy 2021 event.

Left: Art of Health Breathe In competition 2nd place, Progress Nyandoro.

Above: Children, Cities and Climate All4Climate - Italy 2021 event panel discussion and interactive session.

Above: Tino Mavimba, Coordinator of the Art of Health competition presenting artwork by Shamie Dube at the Children, Cities and Climate All4Climate - Italy 2021 event.

Above: Clean air, brighter futures – Children, Cities and Climate youth voices video.

Considerations and limitations

Limitations of the co-benefits study include:

1. The results for Asian and African cities are more uncertain than in other settings due to known limitations of the baseline health data used for the modelling. In particular, asthma incidence in Asia and Africa is likely to be underestimated because of limited reporting. We intend to update our estimates as and when improved data becomes available.

2. The estimated PM2.5 and NO_2 levels (and sectoral contributions) in each city are based on simulated global estimates produced at relatively course spatial resolution. These estimates may not always accurately reflect local concentrations/emissions at the city-level, especially in settings where local emissions data are poor.

3. Our representation of net-zero assumed that air pollution reductions consistent with net-zero were achieved by removal of all fossil fuel-related emissions. Actual emissions reductions may be somewhatlower due to the use of sequestration to achieve net-zero (the process of capturing and storing atmospheric carbon dioxide). Our analysis also did not take account of other factors that may influence air pollution levels, such as changes in meteorology.

4. The calculations of current health effects represent the burden attributable to air pollution in one year (at current exposure levels). On the other hand, calculations of the burden attributable to reduced air pollution levels represent the theoretical burden that would be attributable to air pollution in a world with those reduced air pollution levels, and not necessarily the health benefit that could be achieved by air pollution reductions over the short-term (because air pollution health risks reflect long-term exposures and there would be time lag effects between changes in pollution exposure and changes in risk).

Limitations of the youth survey include:

1. The use online recruitment via social media may mean our sample representative of wider populations of children, young people and parents in the cities where respondents live, in particular those who do not have access to computers or smartphones, or who do not use social media.

2. In addition, those clicking on our recruitment adverts may not be representative of the overall population, if the content appeals to certain groups of people (for example those interested in the climate/ environment). Partial mitigation of this will have been achieved through careful design of recruitment adverts/posts; these attempted to appeal to a diverse group of respondents through the use of phrases and images designed to appeal to different groups.

3. Online surveying (especially without provision of compensation to participants for their time) necessitates the survey being brief in order to gain large response rates that are not biased towards those with particular interest in the topic. This means that the depth of responses will be limited.

4. Recruitment adverts were biased towards lower cost markets within the targeting criteria; despite our attempts to cap recruitment in over-represented cities, our sample is still heavily biased towards low-income (and more polluted) cities, likely influencing the high proportions who are reporting air pollution as a major concern.

Ethics

This study was approved by the LSHTM Research Ethics Committee, references 26311 (co-benefits analysis) and 26313 (youth survey). Informed consent was required from all survey respondents. In addition, local authorities were written to in all the focal cities to inform them about the research, and to offer briefings on the emerging results.

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