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# Leadership and air quality index at Latin American metropolises

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**Abstract** Around the world, quality of life has been important thing for governments, there are several quality indices they are add to the main quality index, someone countries measure the air quality and they are observing them relation with the environmental health indicators (EHIs), there are several articles about explain the health affectation for air quality, but the policy has differences between developer countries and pored countries underdeveloped, the low air quality could be caused respiratory infections and increase the infant mortality. This paper describes the city leadership for some countries in Latin America which have developed policies and implement instruments to sensing the air quality index continuously, this is not only enough, each country has adopted mitigation programs to improve air quality.
There are some indicator to measure the air quality indices, in this review one can find a two principal indicators and ten cities to compare in two variables, likewise they are taken as overall PM10 and PM2.5, each indicator is related with the size of particle there are into the pollution, the paper derives from the research about works related with the air pollution, health indices, and air quality influence, however the governments in Latin American cities have absence to guarantee higher air quality standards for them citizens, finally the air quality city leadership is find to case for Latin America capital cities.

## 1 Introduction

In the last decade, the life quality has been becoming a great element for government health control the air quality face is some important for huge cities, currently more countries have several policies to improve the air quality indices, the most important index for environmental is Environmental Health Indicators (EHIs), (Beall et al. 2011), there are an indicators groups where they are applied to find measures of environmental conditions for humans in each city, the measurements surrender complex data and information for providing a quantitative information can help to identify bias or trends, the cited conclusion is about the life quality indicator are related with the human health and air quality conditions, in other hand data bases have been created to analyse air quality indices by geographical distribution there are around 231 articles published over the last decade on the desert dust impact on air quality (De Longueville et al. 2010), there are exist several data bases for approach research goals using web tools like ISI web.

Some countries and cities are worried for the environmental quality, for this reason a lot of regions are developing research about thing, technological tools and methods to reduce pollution indices in them cities and countries, for example several large cities around the world have studies about to find the air quality concentration levels like the European Union (EU) (Cecchel 2018; or Guariso and Volta 2018). The SO2 keeps a downhill tendency in the air quality situation in the worldwide indicators, Asia has the excessing values for up 300 μg/m3 for some cities. Other indicator demonstrating the global trouble, for example Ozone exceed the average line in some world zones. Countries want to reduce the pollution levels and bad gases concentration for this one, they have created a strong restriction to get control like a local government and policy. However, the control on the air pollutants remain high into some third World countries (Baldasano et al. 2003).

However, there are troubles around the air quality sustainability, the cost for tools and programs are expensive for some governments that have a lot of priority problems to attend, likewise some academies and private companies recognize the importance for this index to the world sustainability, something has been developed air quality plants with low cost and environmentally effective, some papers show the assessing to get a balance cost-benefit and environmental analysis in a large regions likewise they want for covering a large field spectrums (Carnevale 2012; or Carnevale et al. 2018) the idea about develop a sustainable model around the air quality will design and build a new technological tools to transform energy cleanly, however each country has a different air quality indices (AQIs) over a regional scale domain, but it could be a problem because some poor countries will not have access or have limited access to technology.

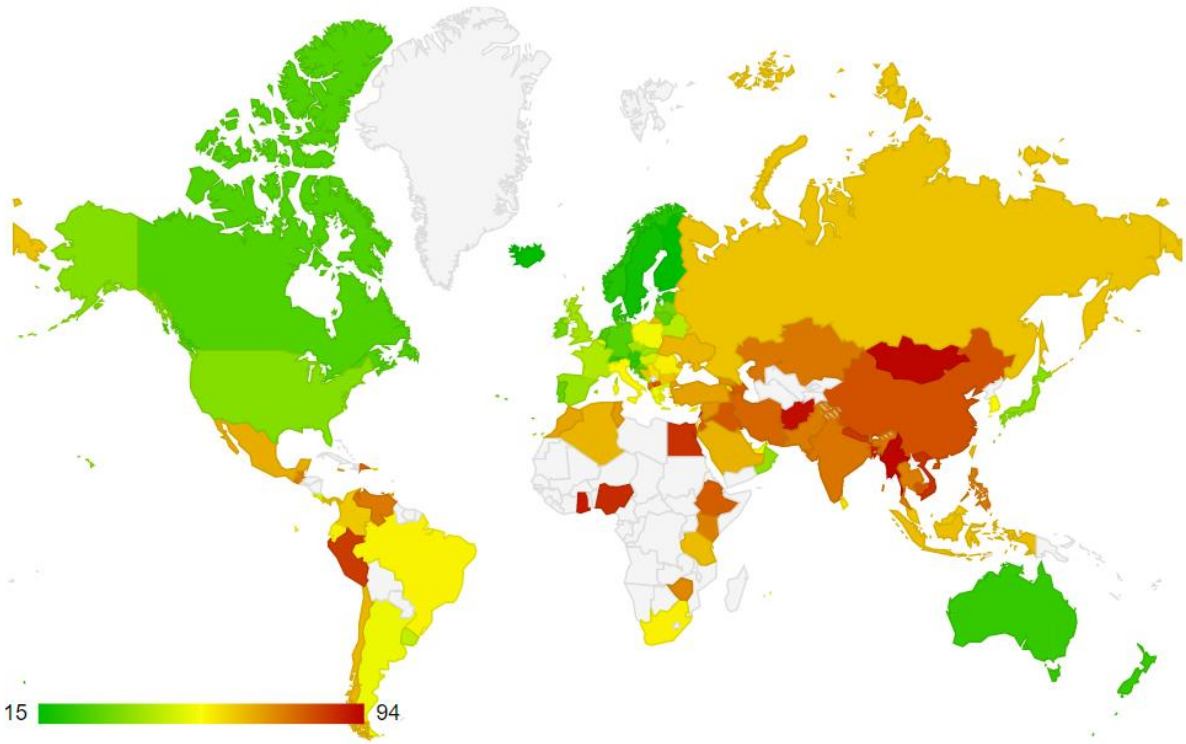


**Fig. 1.** Global pollution index map, red colour indicates less air quality, that is more pollution density
Source: Own results based on Numbeo (2019)

Fig. 1 above shows the impact on air quality in the different countries around the world that has a measurement system implemented in the last year, one of the Latin American countries with the highest pollution index is Peru followed by Venezuela, this suggests that the policies implemented by countries with the worst air quality indexes are those that have a poor air quality policy or that despite a strong policy such as the case of China and Mongolia, it has a government control remains weak.

Some cities like Sao Pablo in Brazil has been studied about the health challenging aspect another effects of air pollution, there are someone variables as PM10 this mean to air have a <=10um in heterogenic composition suspended particle, (O3) ozone in percent, PM2.5 <=2.5um in heterogenic composition suspended particle, there are other chemical composition important to human health like a SO2, CO2, CO NO2 (Bell et al. 2011), in other hand Bogota – Colombia using the community Multi-scale air quality (CMAQ) model (Nedbor-Gross et al. 2018; or Rodríguez-Villamizar et al. 2019), the pollution are generating poor health and deprivation, also circulatory problems, there is a piloted tool called Health and Air Pollution Risk Assessment/Area Prioritisation (HAP-RAP), (Brunt and Jones 2019), some countries have been seen inverting in air quality maintenance because it is more profitable that treat the diseases of the population this cost is around to US$ 845,967,999 (Alvis-Zakzuk et al. 2019).

Finally, this paper shows an study for discovery which city form Latin America is the leadership in air quality care, approach quality goals and it is an example for another cities, although it city have had to invert a lot money to maintain the air quality with a much better control, several researchers match the Latin American population could be at risk, because the combination of elevated pollution, high quantity and population density, also there are exist a high children percentage they are exposed to low levels of quality air, exceeding the pollution indices the World Health Organization (WHO) (see WHO 2000; or Gaitán et al. 2007).

## 2 Metrology to find air quality cities leadership

Next to analyse several papers to find some features about how some cities form Latin American metropolises face the air quality challenge, the healthy is the most important indicator for the cities show interest into measure the air quality indices, there are some study case where the experiments analyse several segments of populations, range in age, sectors, diet another. First there are two indicators to compare for each city PM10 and PM2.5 and consider only level of pollutant. Second, some papers were analysed the worse of the cases and build a table for compare each aspect of air quality index.

There are other indices to analyse but this paper gets the most important for the citizens, there are environmental factors that improve the air quality, like biodiversity, air currents, herbage, populations density and contaminant agents like cars, factories and others.

For each city, the analysis for each one had the highest particle levels, resulting in the poor ranking for Environmental Health Indicators (EHI), the citizens exposed is important variable because, when it was analysed the <15 years population exposed it is when the children have been affected for pollution, for example one city has a high population density but de PM10 and PM2,5 particles are disperse in a short place, while the city have a long space that so lower density but the PM10 and PM2.5 high particles concentration are more dangerous or there are more risk to health affected when the particles density increase.

Some governments have focused on developing indicators for knowing the impact for human health, but it is following a purpose it is oriented to estimating damages caused from industry, transportation, waste, energy generation, and other polluting jobs, four objectives have been finding in this way:

1. Know and understand the human health and environmental effects for government policies.
2. Design indicators and quantify the estate of environmental condition related with human health.
3. Measure indicator in the timeline and place geo - localization, it permits to approach the proposal governmental goals.
4. Civic culture for environmental care and health.

When a government measure uses effective methods, it can take a good decision to face the air quality troubles, for example the effective future decision could affect the humans quality life for a worn government decision it was taken before the policy was implemented, there are some powerful tools to get a achievable goals, chose options among better alternatives and propose new polices.

What is most interesting to observe a government with air quality is when this pollution and pollutants that make up the air of a certain population into a zones or area, is the impact that can cause human health and its relationship with mortality rates, respiratory diseases and life quality of citizens, for this reason a classification of indicators separated by descriptive indicators is made, which reflect the state of human health, performance indicators which can indicate elements of goal the target, regulation, standards, particular situations that they alter the air quality standards (Example: "*Pico y Placa*" in Bogota - Colombia), efficiency indicators they indicate direct relationship between the industrial production of a certain area or the energy consumption per unit of output or level of contamination and indicators for welfare that relate economic, social and political margins.

The EHI takes as a reference for air quality and its effect on human health parameters such as emission sources, emission levels, concentration in the environment, indoor pollution levels, exposure per person, exposed population, disease rates and Impact on the environment. There are other characteristics such as meteorological, social and economic that affect the behaviour of air quality identifiers in a certain area, however in this work the use of internal indicators and particle size indicators will be taken for analysis, which is relevant and it has been shown that it is closely related to respiratory diseases and pollution generated by factors typical of urban areas.

As part of the air quality indices, these can be grouped into two groups that depend on the composition of the materials that are part of the suspended particles, such as concentration of nitrogen dioxide, sulphur dioxide and another group related to size of the particle that is in suspension between 2.5um and 10um particle diameter.

For this analysis proposed in paper, proceed with a comparative methodology with a broad spectrum, which through the measurement of the particle size suspended in the air and its density, for this reason only use the PM10 and PM2.5 to be analysed, compiling results found in several bibliography and previous studies carried out in several Latin America cities.

## 3 Results

A lot of countries have policy controls about air quality, but some metropolises do not have enough controls for guarantee the air quality on all cities, but there are some controls that are the most common in Latin American countries, such is the reason to analyse the results that were found in the bibliography and that are useful to represent a comparison between a couple of these variables that are implemented in the 10 metropolises as the object of this study.

As shown in some studies, air quality requires several indicators to estimate a good measurement, but nevertheless the results described in this document only allow us to estimate which is the city where it could have a greater affectation of the given population due to population density, that is to say that cities with a poor indicator of PM10 or PM2.5 where there is a greater amount of exposed population would have the worst indices, that is like a citizen he would like to have a better quality of life, he would look for a place with the lowest number of people and better index PM10.

Table 1 shows the ranking of ten Latin American metropolises where the first place represents the best city and the ten the worst, for this one consider the PM10 and PM2,5 concentrations and consider an annual frequency

window, the analysis has a capital cities from Brazil – Sao Paulo, Colombia – Bogota, Mexico – Mexico City, Peru – Lima, Ecuador – Quito, Nicaragua – Managua, El Salvador – San Salvador, Chile – Santiago de Chile, Argentina – Buenos Aires, and Uruguay – Montevideo.

**Table 1.** Cities and comparison air quality indices (2011 window)

| City – Population Approx. | Air quality index | Description |
|---|---|---|
| Managua - 2,223,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. The capital city is the best in air quality indices. |
| Quito – 1,619,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| San Salvador – 238,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| Montevideo – 1,381,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| Santiago – 5,106,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| Bogotá – 6,768,000 | PM10, PM2.5 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. PM2.5 average. |
| Sao Paulo – 11,220,000 | PM10. PM2,5 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. PM2.5 average. |
| Lima – 7,168,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| Mexico City – 8,855,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. |
| Buenos Aires – 2,890,000 | PM10 | PM10 was analysed using EHI-B indicator, it is average PM10 weighted by population. The capital city is the worst in air quality indices. |

Source: Own results based on Bell (2011)

Using comparison criteria, it could be analysed that the metropolis with the highest risk of developing diseases caused by poor air quality are Lima, Mexico City and Buenos Aires. while on the opposite the cities that represent a lower risk are Managua, Quito and San Salvador, but if this information was analysed from another point of view, such as population density, it can be found that more populated cities such as Bogota, Sao Paulo and Mexico City, they are in an intermediate level, that is to say, they are cities that are in a more stable term of air quality control, however it is clear that the cities with the lowest population rate are the least contaminated or otherwise see the case of San Salvador where its population quantity is the lowest but the level of the air quality indicator PM10 is not the best.

## 4 Conclusions

During the search for information to obtain an accurate analysis, it was found that most documentation is biased to the analysis of specific cases or a single indicator, there are few work on general or standardized analysis, for this reason the work shows an analysis which allows you to establish that population densities are not related or are not directly proportional to the pollution levels that are generated in a metropolis, for this reason there are other factors such as industrial production, climate, meteorological, social, economic and political factors, they can influence these results.

There is a lack of greater precision and capacity of governments to establish policies and metrics that allow a greater understanding and environmental comparison factors that affect human health, it is considered that greater efforts should be made to obtain more standardized studies with continuous monitoring capacity of the air quality indices, on the other hand in general it is required a stricter policies against the controls that must be carried out to improve air quality.

Finally, it is expected to broaden the scope of the present study in order to determine factors that may affect the population by typifying it by age, gender, occupation, among other factors that allow establishing in greater detail the effect of exposure to these types of environments and how to identify a health affectation early.

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