Air Quality - Recognition and Perception of Problems by Individuals

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Abstract:

The article presents the results of a study on subjective opinions of Europeans in two generations Y and BB. Due to the lack of data, the assessments made by residents of only 23 EU member countries were analyzed. These assessments concerned air quality, actions taken by decision-makers to improve air quality, and knowledge and awareness of the threats related to air pollution. The data came from the Eurobarometer surveys conducted in 2012 and 2019. A correspondence analysis of concatenated tables with supplementary points and aggregate measures of development were used to find relationships between generations from different countries and to indicate changes in the perception of air pollution. The aim of the study has been achieved. The areas where differences and similarities between generations occur, and where opinions expressed by a generation change over time have been identified. The Problems that require solving have been indicated so that individual actions leading to the improvement of air quality could be assessed.

Keywords: air pollution; climate change; generation Y; generation BB; correspondence analysis; aggregate; development.

JEL Classification: Q52; Q53; C38

Introduction

An individual perception and recognition of the threats to the normal functioning of humans as well as an attitude to those risks are important factors which create pro-ecological behavior. The way people perceive the threats related to air and environmental pollution as well as all climate changes that affect them influences the behavior of an individual and their community. It also has an impact on the decisions made by regional and national decision-making bodies and the establishment of international guidelines. At the same time, it should be noted that an individual belongs to a group of entities significantly contributing to air and natural environment pollution. The quality of household running affects the environment and, consequently exacerbates climate change. However, the extent of the impact of these individual factors may be diverse as it may be dependent on such variables as individual awareness, influence of the community the level of subjective responsibility, the willingness to counteract climate change and individual personality traits considered adverse for example, fear of the risk of losing current benefits, fear of expressing one's own opinions, distrust or reluctance to change.

1. Research Background

Both environmental pollutions, especially air and water pollution, and climate change are a recurring theme in the media. A person exposed to this information, involuntarily begins to analyzed it and becomes aware of the resulting dangers. Of course, it cannot be indicated that we all react the same when we receive certain information about threats to the natural environment.

However, the number of people pointing to the existence of this type of threat is certainly increasing. However, the mere recognition of the problem is not sufficient. In addition to being aware it is imperative that people take individual action and demand regional, national and global actions to save our planet. According to the WHO (World Health Organization [WHO] 2021), air pollution is currently perceived as the most important threat to human health and life. For research purposes we adopted the hypothesis that BB and Y Europeans do not differ significantly in their assessment of the current problems related to air pollution. This is due to the family and professional situations in which these two generations are placed. People from the Y generation are more often

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informed about the dangers of air pollution as early as at school, their awareness is greater due to the rapid acquisition and transfer of information in social media. On the other hand, people from the BB generation already have an established professional and family situation, which allows them to turn to social activities. The study was also designed to confirm the hypothesis that over time, the assessments of threats related to air pollution in both generations change, *i.e*. individuals react to public information related to air pollution and their awareness of air quality changes. The aim of the article is therefore to search for differences and similarities between the generations, but also within the generations, also considering the passage of time.

The foreword in WHO report (WHO 2021) begins with the statement that "clean air is fundamental to health". Air pollution is defined as the presence of solid particles and gases in the air (United States Environmental Protection Agency [US EPA] 2020). However, it can be in the internal and external environment, with the use of physical, chemical but also biological means. Air pollution modifies the natural environment (WHO 2000). In the definition by Statistics Poland (Bochenek *et al.* 2020), it is indicated that air pollution is a result of human activity. And it is the introduction of solid, liquid or gaseous substances into the air, and their amount, which has a destructive effect on the natural environment, climate and human health.

Air pollution mostly translates to the quality of human health. However, this is not solely a human problem as air pollution negatively affects all living beings either directly or indirectly. Apart from health and life quality it also affects the natural environment, climate change, historical heritage, and the economy of many countries (European Environmental Agency [EEA] 2020, Ustawa Dz. U. 2001 Nr 62/627, WHO 2021, United Nations [UN] 2019, UN 2021). By specifying the direction of air pollution impact in detail, the scope of this impact on the factors associated with the areas indicated can be determined. Air pollution affects natural ecosystems and biodiversity. Emissions disrupt terrestrial and aquatic ecosystems. There is a subsequent oversupply of nutrients which reduces the species diversity; air pollution contributes to the acidification of soil, lakes and rivers and subsequently interferes with biodiversity. As a result of reducing their growth rates, agricultural crops, forests and plants are also damaged. Air pollution and climate change are intertwined (they do not function separately). The pollution factors, *e.g.* greenhouse gases contribute to the formation of ground-level ozone. Climate change affects formation and repositioning of air pollutants in the atmosphere.

Apart from triggering changes in the environment, air pollution affects human health. The increasing number of diseases related to air pollution may cause the inefficiency of the healthcare system. Diseases caused by air pollution vary as to how serious their consequences are ranging from mild (EEA 2013, EEA 2021, WHO 2021) discomfort in the usual Lung function, irritation of eyes, nose and throat to serious conditions *e.g.* respiratory symptoms, asthma attacks, cardiac problems and often lung cancer. Air pollution can affect normal brain functioning and has an impact on the central nervous system, liver, spleen, blood and the reproductive system. Ultimately, this can be fatal.

Having such a negative impact on human health, climate change, the ecosystem and cultural heritage, air pollution relates to market and non-market costs, labor market, health system, well-being, poverty and social exclusion. Air pollution assessed locally may affect not only the tourist attractiveness of this particular place but also its appeal to highly-skilled individuals seeking new job opportunities (Green Growth Best Practice [GGBP] July 2014).

The presented definitions of air pollution clearly indicate that it is mainly man who is responsible for this global problem. Hansen *et al.* (2012, E2415) point to „human made global warming". Whereas, Olabe (September 2015, p. 5) points to the destruction of the natural environment by man much more clearly, because man has the ability to "destabilize the life-support functions of the biosphere". And this takes a heavy toll not only on human health but on all living beings. For this reason, it is important to take appropriate measures to protect the air and reduce climate change.

To ensure the best possible air quality, air pollution is keeping up the levels of substances in the air below the permissible levels for them or at least at these levels (Ustawa Dz. U. 2001 Nr 62/627). Legal regulations related to air protection also apply to situations when the levels of pollution are exceeded and when a long-term policy is established. Compliance with the standards involves not exceeding the air quality standards for the protection of health in accordance with the guidelines of the European Commission, WHO and UN Economic Commission for Europe (DIRECTIVE 2008/50/EC, United Nations Economic Commission for Europe [UNECE] 2011, WHO 2006). The indicated air pollution standards define the amounts of emissions of PM2.5, PM10, NO2, O3, BaP and others to the air (WHO 2021). Air quality guidelines and standards are mainly supported by decision makers. Individual assessment of these indicators without having the ability to recognize the threat and realize responsibility for their levels is a stressor for an individual, which affects the level of irritation in the perception of environmental pollution. Therefore, reliable, public information related to air pollution and the possibilities of counteracting the emission of

pollutants is essential. Chiarini *et al.* (2021) indicates that the individual perception of air quality is related to the social dimension of sustainable development, which goes hand in hand with the environmental and economic dimensions. However, in order to be able to take the right action and correctly define hazards, sufficient knowledge is required. According to Lammel (2015), care for the environment is possible only after some subjective assessment resulting from individual attitudes towards the natural environment.

The level and scope of care for the environment results not only from knowledge, but also from beliefs, individual responsibility, risk assessment, health, the impact of the individual's environment and individual predispositions to undertake new activities. If the effects of climate change do not directly affect an individual or are felt by them to a small extent, then concerns about climate change are temporary (Lammel 2015). Besides, their perception and responsibility for climate change are related in a complex and dynamic way (Qin *et al.* 2015). Many people find it difficult to define the causes and effects of climate change (Renn 2011).

Dissemination of knowledge/information about climate change and air pollution will change perception and risk assessment. The perception of risk is influenced by facts, knowledge, personal preferences and attitudes, individual judgments, and social role (Cori *et al.* 2020). Taking actions related to reducing air pollution depends on the propensity to risk related to changing the current lifestyle, daily life or consumption patterns but also beliefs, values and attitudes, behaviors, environmental pressures, action and reaction of the society and a role an individual play in the society (Cori 2020, Sundblad *et al.* 2014, Renn 2011).

The assessment of air quality related risks is firstly assessed locally by individuals (Hansen 2012). The recognition of threats in one's own environment means that care for the local environment may turn into a global concern. The behavior of an individual within and outside a social group shapes actions and reactions of other entities in the society, which then affects the scope of new policies regarding air quality (Renn 2011). Thus, the responsibility for air pollution cannot only be assigned to politicians, entrepreneurs or decision makers, but also to social groups and individuals.

The presented scope of the research problem indicates the need to recognize subjective assessments of individuals regarding the air quality problem and their feeling of individual responsibility that influences their actions to improve the air quality. Our research also covers European activities related to a better air quality.

2. Data and Scope of Analysis

Two data sources of Eurobarometer (European Commission [EC] 2013, EC 2021) were used in the study: Flash (2012) and Standard (2019). Observations for generations Y and BB were selected from both databases. Each cohort was divided into two groups, each year receiving the study groups Y1 (16-21 years old in 2012, 20-28 in 2019), Y2 (22-31 years old in 2012, 29-38 in 2019), BB1 (48-55 years old in 2012, 55-62 in 2019) and BB2 (56-66 years old in 2012, and 63-73 in 2019).

In the following years, the range of age cohorts changed – the respondents were getting older. The participants in the Eurobarometer's study were all EU Member States, but due to a lack of data and permanent membership in both years, we finally did not include Croatia, Cyprus, Estonia, Luxembourg, Malta. A total of 13,781 people participated in the study in 2012. In the Y1, Y2, BB1 and BB2 age groups, respectively, there were 2,107, 3,827, 3,586, 4,261 people. In 2019, 14353 people participated in the study and respectively in the Y1, Y2, BB1 and BB2 age groups there were 3,390, 4,101, 3,318, 4,544 people. From the Eurobarometer surveys, we used questions that did not change and constantly appeared in the consecutive years:

X1: How informed do you feel about air quality problems in your country? (very well informed; well informed; not well informed; not informed at all; don't know);

X2: Do you think that, over the last 10 years, the air quality in your country has: improved; stayed the same; deteriorated, don't know;

X3: Have you heard of the EU air quality standards? (yes, no, don't know);

X4: Do you believe that the existing EU air quality standards are adequate or not? (Yes, they are adequate and do not need to be changed; No, they should be strengthened; No, they should be weakened);

X5: In your opinion, is each of the following currently doing too much, doing about the right amount or not doing enough to promote good air quality in your country? (households, farmers, energy producers, car manufacturers, public authorities);

X6: In your opinion, at what level should the issue of air pollution be addressed (local, national, EU)?

X7: In your opinion, which of the following are or would be the most effective ways of tackling problems of air quality? (possible answers in Section 7);

X8: In order to reduce harmful emissions have you done any of the following in the last two years?

In question X8, Europeans could choose from the following responses: changed housing heating system from higher-emitting to lower-emitting; replaced older energy using equipment with newer one having better energy efficiency rating; frequent user of public transport, cycling or walking instead of using car; bought a low emission car; bought low-emitting products to fuel open fire or barbecue; other, none, don't know.

Each of the questions has a different measurement scale. We used appropriate methods for the analysis and in accordance with the objectives of the study. We divided the study into four parts. In the first one, we focused on people who said that they did not know whether they were well or badly informed about the air quality in their country. The second analysis consisted of X1-X4 questions related to knowledge and perception of the air pollution problem. The next analysis included the questions X3 (yes), X5, X6 (l, n, EU) and concerned the assessment of actions taken in the field of air quality assurance. The next analysis concerned the seventh question, *i.e.* changes in the assessment of the ways to be followed to effectively achieve the goal of better air quality. The analysis of question X8 was additionally performed because the method of measuring this variable required additional information on the characteristics of the population, which, unfortunately, is not available in any of the Eurobarometer surveys (see Conclusions).

3. Applied Research Methods

In order to verify the hypotheses and realize the postulated research problem, correspondence analysis and Aggregate measures of development were used. Correspondence analysis (CA) has been widely described in literature. For instance, CA features in many publications by Greenacre (1984, 2010), Stanimir (2005), as well as those by Backhaus *et al.* (2003), Blasius (2001), Lebart, Morineau and Warwick (1984). This article does not present the algorithm of CA, but merely refers to the special construction of data tables, indicators and assumptions regarding the correctness of the conclusions reached.

Using CA, it is possible to examine the relations between the categories of non-metric variables. The result of this method is an indication of the groups of coexistent categories and their graphic presentation. Considerations in this study point to the application of correspondence analysis of multiple variables. The main issue to be dealt with during the analysis is the loss of information about the connections between the categories, which takes place when their full-dimensional space is reduced. In such a case one of the following approaches can be used:

- the Burt matrix – symmetric block matrix including all the analyzed variables, in which on the main diagonal there are diagonal matrices containing numbers of occurrences of the categories of the following variables. Beyond the diagonal there are contingency tables of the pairs of variables; relationships of the variable categories is K-dimensional:

$$K = \sum_{q=1}^{Q}(J_q - 1) = J - Q \quad (1)$$

where: J_q – number of categories in q-th variable, $J = \sum_{q=1}^{Q} J_q$ – number of categories in all study variables, Q number of variables;

- the concatenated table – a matrix that consists of several contingency tables in which one of the variables repeats (common variable); the CA of such a matrix is carried out according to the classical approach for contingency table; the full space for analyzing the relationships of the variable categories is K-dimensional:

$$K = \min\left(P - 1; \sum_{q=1}^{Q} J_q - 1\right) \quad (2)$$

where: P number of common variable's categories (the number of columns in concatenated table); $\sum_{q=1}^{Q} J_q$ number of categories of the remaining Q variables (number of rows in concatenated table); $q = 1, \ldots, Q$.

The CA of the Burt matrix is carried out using the eigenvalue decomposition, and of the concatenated table using singular value decomposition. In both analyses the total inertia (or simply the inertia) is calculated as the sum of all eigenvalues (squared singular values). In assessing the quality of display of the categories' relationships in the low dimension $K^* < K$, two methods are very often used. The first is the Cattel test (it presents eigenvalues in non-ascending order) and cumulative value of contribution of each eigenvalue to total inertia (qualities or explained variance of K^* each dimension). In both described above types of CA, it is possible to add supplementary points. It means that on K^*-dimensional display the categories projection of additional variables is possible. The

supplementary points (illustrative, passive) have no influence on the construction of axes and total inertia. They have only a supporting or complementary role in the analysis.

Aggregate measures of development make it possible to compare objects. In our study, when comparing objects, *i.e.* European countries. In the study of assessing actions taken to ensure air quality, the percentage of the choice of the answer variant by respondents in individual countries, broken down by age groups, was used. Since for question X5 the percentage of the choice of the answer not doing enough was used, we got six variables in the type of *negative ideal solution* (destimulants, costs). In the approach described by Śmiech (2004) the recalculation to the type of *positive ideal solution* (stimulants, benefits) was necessary. We used the formula proposed by Śmiech (Eq. 3):

$$x_{ij}^{PI} = 2\bar{x}_{Cj} - x_{ij}^{NI} \tag{3}$$

where: x_{ij}^{PI} – the value of j-th variable as *positive ideal solution*, x_{ij}^{NI} – the value of j-th variable as *negative ideal solution*, $\bar{x}_{Cj}$ – is the arithmetic mean of the j-th variable determined from the observations in the analysed countries (C).

Since, in the study, we asked whether the Europeans assessed actions taken to ensure air quality similarly, we used the following variables' normalization formula (Eq. 4):

$$z_{ij} = \frac{x_{ij}}{\bar{x}_{Cj}} \tag{4}$$

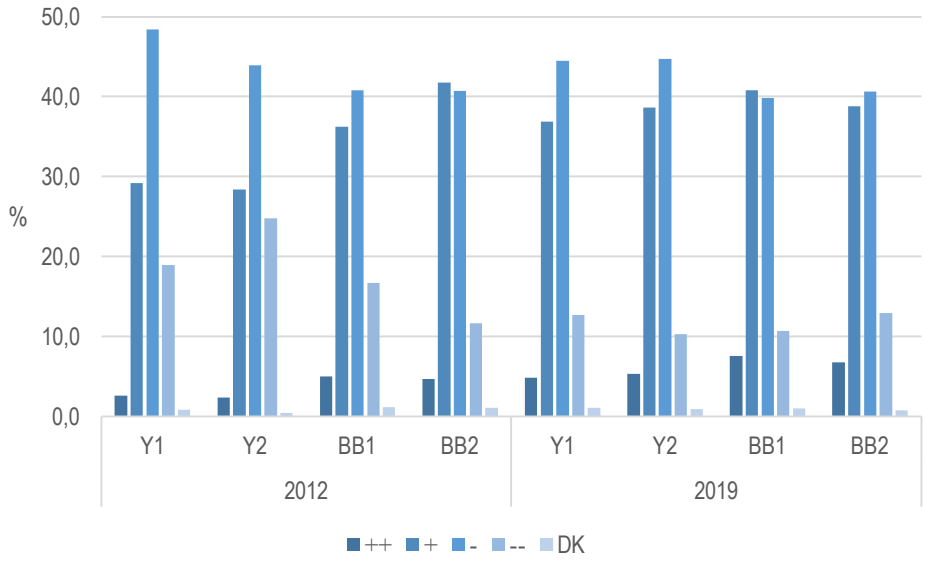
where: x_{ij} (or x_{ij}^{PI}) is the observed percentage of the respondents' choices of the *j*-th variable in the *i*-th object, z_{ij} are the normalized values of the variables in individual countries. This procedure indicates that the reference values are $\bar{x}_{Cj}$.

The aggregate measure of the level of actions taken to ensure air quality assessment is the arithmetic mean of normalized variables for the examined objects. The procedure of calculating synthetic variables for objects and the pattern of changes was applied by Śmiech (2004).

4. The Europeans Uncertain if Their Knowledge about Air Quality is Sufficient

In the first analysis, we focused on the responses of the people who do not know whether they are well or badly informed about air quality problems in their country in 2012 and 2019. There was a very small number of such people in each group – 1% of respondents in 2012 and 2019. For this reason, the assessment of their responses could only be performed for all analyzed countries together. Figure 1 shows the structure of the Europeans' responses to the question about the level of information on air quality in both years.

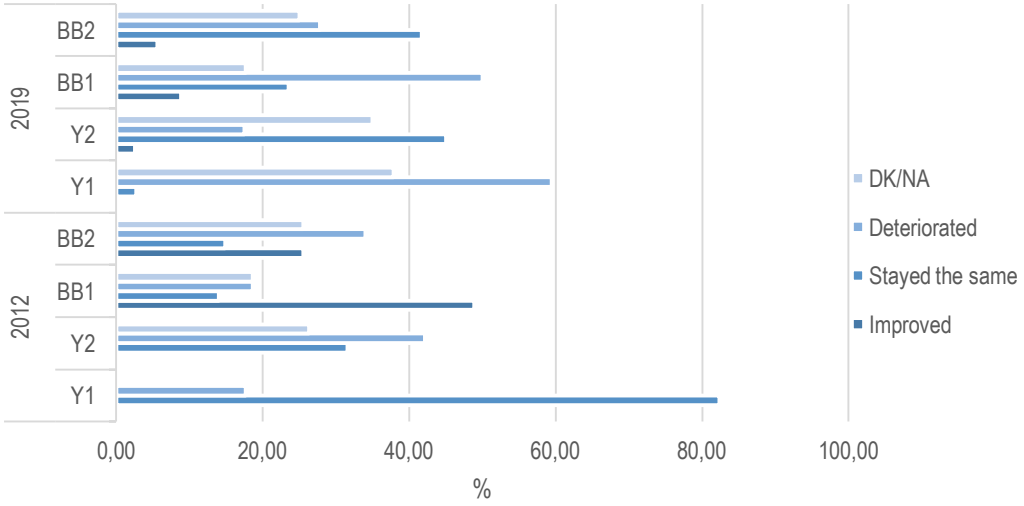
Figure 1. How informed do you feel about air quality problems in your country?



Source: Own elaboration.

The figure shows an increase in the frequency of responses *don't know* (DK) among the two youngest age groups in 2019 compared to 2012. In each age group, there was a significant increase in the share of *very well informed* people (++) in 2019 compared to 2012. Among people *well informed* (+) about air quality problems, the numbers decreased only among BB1 in 2019 compared to 2012. Whereas, in both analyzed years, younger people more often than older people say that they are *not well informed* (-). It is worth noting that in 2012 people from groups Y1, Y2, and BB1 significantly more often than in 2019 indicated that they were *not informed at all* (--). People who either said that they did not know or said that they knew about air quality problems, were asked to rate how the air quality in their country has changed (Figure 2) over the last 10 years.

Figure 2. How the air quality in country has changed over the last 10 years?



Source: Own elaboration.

Among those who are not able to judge the level of information they have about air quality problems in their country, there are those who say that air quality has deteriorated in the last 10 years. These are Y2 and BB2 in 2012, Y1 and BB1 in 2019. The question is how such an assessment is possible, considering these people claim that they do not know whether they are well or badly informed about the state of air quality. They have no basis for making such comparisons.

5. Generations' Recognition of Air Pollution Problems

In order to analyze the knowledge and evaluation of information about air quality made by the generations, we used the answers to three questions X1-X3. The appropriate method of analysis for such a dataset is CA. Reflecting on the technique of its implementation, we assessed the full space dimensions. In the Burt matrix it was $K = J - Q = 31 - 4 = 27$ (countries – 23, X1 – 3, because the total answers of very *well informed* was not high enough so they were added to the category with answers of *well informed*, X2 – 3, X3 – 2). On the other hand, in concatenated table with country as a common variable it was $K = \min(23 - 1; 8 - 1) = 7$. In such a situation, higher values of the quality index of presentation in two-dimensional spaces are expected in the concatenated table analysis. Additionally, we have introduced supplementary points of X4 categories. The respondents who answered *don't know* in analyzed questions were excluded from the analysis.

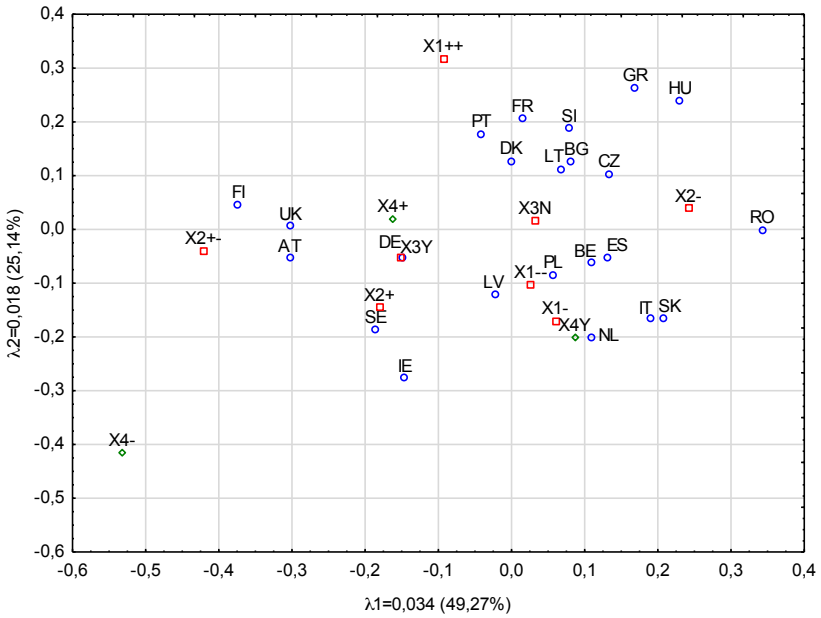
The analysis was performed separately for each age group and separately in both analyzed years, so the CA was conducted eight times. In Figure 3, we present only one graphical presentation of the CA results for group Y1 in 2012. However, we are happy to provide other graphic presentations if required. The results obtained in subsequent analyses are presented in Table 2, and in Table 1 there are indicators assessing the graphical presentation in the space $K^* = 2$.

Table 1. Assessment of two-dimensional presentation of CA results

	2012				2019			
	Y1	Y2	BB1	BB2	Y1	Y2	BB1	BB2
Cattel test	3	2	2	2	2	2	2	2
Quality	74.4	78.3	82.7	82.8	80.9	73.8	83.5	88.2

Source: Own elaboration.

Figure 3. Results of correspondence analysis for generation Y1 in 2012



Source: Own elaboration.

Table 2. Results of correspondence analysis of generations Y1, Y2, BB1, BB2 in 2012 and 2019

	2012			2019			2012			2019			
Y1	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	Y2
	PT, FR	NL	PL, LV	DE, **SI**	BG, IT, RO	-	**AT**	BG	-	LV, LT	**HU**	-	
	X2+	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	
	SE	FI	RO	-	AT	ES	-	IE	RO, FR, GR	-	DE, CZ	BG, IT, FR	
	X3Y	**X3N**		**X3Y**	**X3N**		**X3Y**	**X3N**		**X3Y**	**X3N**		
	DE	-		DE, **SI**	IT, RO, **UK**		AT	NL		**SI**, PT, NL	GR, DK, **UK**		
	X4Y	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	
	NL	DE	-	LT	BE	-	-	PT, DK	-	-	NL	**NL**	
BB1	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	**X1++**	**X1-**	**X1--**	BB2
	AT, **SI**	**LT**	-	UK	**GR, SK, HU**	**IT**	**SI**, **AT**	**LT**	-	**SI**, PT, NL	**SK, GR**	PT, **IT**	
	X2+	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	**X2+**	**X2+-**	**X2-**	
	-	**DE**, IE	**IT**	-	SE, **IE**, AT, LT	**FR, ES**	-	**DE**, NL, DK	**IT**	-	LV, PL, **IE**	**ES**	
	X3Y	**X3N**		**X3Y**	**X3N**		**X3Y**	**X3N**		**X3Y**	**X3N**		
	DK	**LT**		UK	PT, GR, **HU**		-	**LT**		DK	**HU**		
	X4Y	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	**X4Y**	**X4+**	**X4-**	
	AT	AT	**SK**	FI	LV	-	DK	BG	**SK**, BE	DE, SE	LT	**NL**	

Source: Own elaboration.

The values marked as quality in Table 1 indicate the share of the first two eigenvalues in the total inertia. In each analysis, values greater than 70% were obtained for the graphical presentation in two-dimensional space. This is a very good result considering that the full-dimensional space is 7. Also, the Cattel test indicates that the presentation of the CA results should be done in two-dimensional space.

Based on Figure 2 and the assessment of the configuration of points illustrating the countries and answers to questions X1-X3, it can be indicated how in 2012 people aged 16-21 (Y1) assessed information on air quality in their country. The Portuguese and the French believed that they were very *well informed* (X1++) about the air quality in their country, the Dutch believed that they were *not well informed* (X1-), Poles and Lithuanians said they were *not informed at all* (X1--) about the air quality in their country. Regarding the change in air quality over the last 10 years, the Swedes believed that it had *improved* (X2+), the Finns believed that it had *not changed* (X2+-), and the Romanians believed that it had *deteriorated* (X2-). Germans have *heard about the EU standards* (X3+), but it was not possible to indicate a country where the inhabitants would clearly (unequivocally) say that they had *not heard about these standards* (X3-). The Germans believed that these standards *should be weakened* (X4+). In no country was there a strong stance on *strengthening the standards* (X4-), and the Dutch believed that the current standards are *adequate and do not need to be changed* (X4Y). These conclusions were put down in Table 2 (fragment Y1-2012), as well as the conclusions from the analyses carried out in the subsequent age groups in both years.

In the analysis, we were looking not only at the level of perception of information on air quality, but also at similarities and differences between the generations. We were also interested in changes in the recognition of information availability with age, *i.e.* between 2012 and 2019. In Table 2, we marked with yellow no difference in the assessment of variables by the selected age group of a given country in 2012 and 2019. Within 7 years, from 2012 to 2019, most opinions on air quality information differ in each age group. It can be indicated that the youngest Germans had an unchanging opinion about their knowledge of air quality standards (X3Y in 2012 and 2019). The older French from the Y generation, both in 2012 and 2019, believed that the air quality had deteriorated over the last 10 years (X2- for the Y2 group). The Irish from the BB1 group, both in 2012 and 2019, believed that air quality in Ireland had not changed in the last 10 years. The oldest Slovenes believe that they keep being very well informed about air quality problems (X1++ for BB2 in 2012 and 2019). It follows that in all analyzed age groups, opinions on the aspects described in questions X1-X4 changed over time. We saw one improvement in the rating, namely in group Y2 in 2012, the Dutch declared that they did not know the EU air quality standards. In 2019 this group indicated knowledge of these standards.

In both age groups of the BB generation, compared to both age groups of generation Y, there are more countries where the inhabitants defined their level (high or low) of knowledge and information about air quality problems. This may indicate a greater, than among the Y generation, individual interest in the problems of air pollution followed by seeking information about the situation in a particular country.

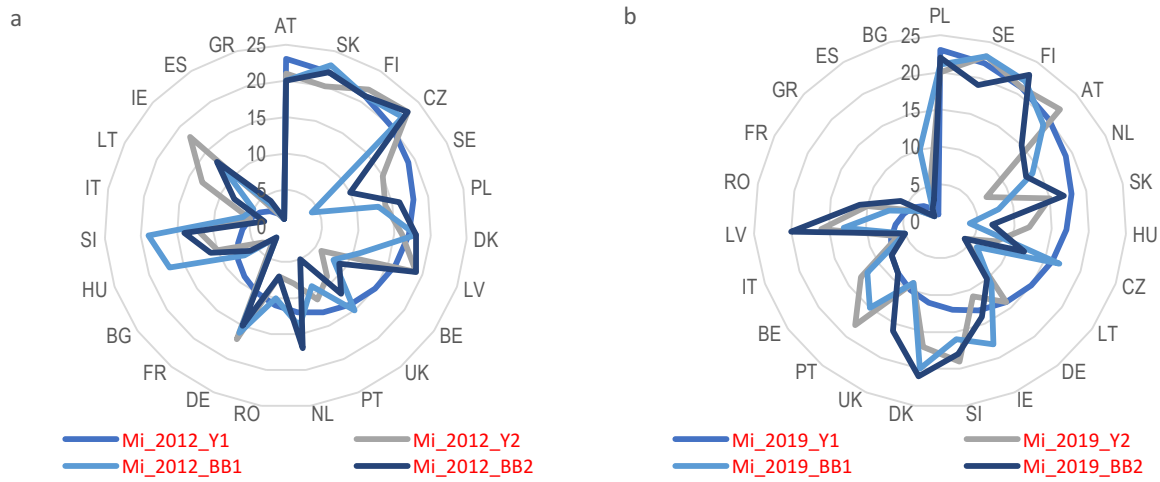
In Table 2, we have marked the similarities between younger and older people in a given year in red. In 2012, Austrians from groups Y2, BB1 and BB2 rated the level of information on air quality as very high (X1++), and among Slovenes a similar rating was given by people from groups BB1 and BB2. The level of information on air quality problems was assessed as not very high (X1-) by Lithuanians from both groups of the BB generation. Germans from both BB groups stated that the air quality in their country had not changed in the last 10 years, while Italians from the same age groups stated that air quality had deteriorated. Lithuanians from BB1 and BB2 groups in 2012 did not know the EU standards for air quality, and Slovaks from the same groups indicated that these standards should be weakened. In 2012, most similarities in the assessments of the air pollution problem can be observed between younger and older people from the BB generation.

In 2019 (Table 2), the Slovenes from groups Y1 and BB1 indicated that they were very well informed (X1++) about the problems related to air quality. On the other hand, Hungarians from groups Y2 and BB1, as well as Greeks and Slovaks from groups BB1 and BB2 assessed the level of information about air quality problems as moderately poor (X1-). Italians of the two groups of BB generation claimed that they did not have any information about problems (X1--) air quality in Italy. The Irish across the BB generation stated that air quality had not changed over the last 10 years (X2+-), and the French (Y2 + BB1) and the Spanish (BB1 + BB2) considered that air quality had deteriorated over the last 10 years (X2-). The knowledge of the EU (X3Y) standards was indicated by Slovenes from two groups of the Y generation. However, the lack of this knowledge was indicated by the residents of the UK from groups Y1 and Y2, and Hungarians from the two oldest groups. The Dutch from groups Y1 and BB2 indicated that the EU standards regarding air quality should be weakened (X4-). In 2019, there were more similarities between the analyzed age groups than in 2012, but these similarities concerned younger and older people within one generation.

6. Assessment of Actions Taken to Ensure Air Quality

The aim of the study was to check whether the generations have the same assessment of actions taken by various entities to reduce air pollution (X5). This analysis also considered opinions about the level at which the issue of air pollution should be addressed (X6), and the knowledge of the EU air quality standards (X3). The result of the analysis is Aggregate Measures of Development calculated for 2012 and 2019 respectively. This enabled us to indicate which generations in both years gave a better rating to public actions leading to good air quality. Figure 4 (*a)* for 2012 and *b)* for 2019) presents the ordering (ranking) of countries from the one with a higher score in the analysis (*i.e*. 23) as assessed by generation Y. The highest value indicated the highest rating given by generations (separately for Y1, Y2, BB1, BB2) to public actions undertaken to improve air quality in a given country.

Figure 3. Results of generational assessments of actions taken to ensure air quality (a – 2012, b – 2019)



Source: Own elaboration.

Both in 2012 and in 2019, very high ratings for measures to ensure high air quality were given by people from all analyzed age groups in Austria and Finland (Figure 4a and Figure 4b). On the other hand, these activities were rated the worst by all younger and older people from both generations in Spain and Greece. In 2012, actions to protect air quality were rated very high by all Slovaks, while the ratings given in age groups in 2019 diverse a lot: the worst rating (significantly lower than the rating indicated by Y1) was given by younger people from the BB generation, and the ratings given by the oldest people (BB2) is almost consistent with the assessment of the youngest (Y1). It is also worth paying attention to Hungary, where in 2012 the opinion of the youngest people was much worse than that of the younger people from the BB generation. On the other hand, in 2019, the opinion of people in the Y1 group about actions taken to improve air quality was much higher than in the BB1 group. In Latvia, people from the Y2 and BB1 generation assessed actions to protect air quality similarly and better than Y1 and BB2. Whereas in 2019 the opinions of all people older than Y1 remained at a similar level in the ranking as in 2012, but the rating given by Y1 was much worse. The opinions of all Danes in 2012 indicate a high assessment of actions taken both by their country and by the EU. On the other hand, the opinion of the youngest people (Y1) in 2019 about pro-quality activities in Denmark was much worse than in 2012. The opinions of people from the two oldest groups of Danes in 2019 indicated a better assessment of the activities than in 2012. In 2019, all Poles from both Y and BB generations rated the activities the highest. In 2012, the rating of these activities by BB1 was one of the lowest.

7. Ways to Reduce Air Pollution

The presented analyses show that Europeans in designated age groups in many countries similarly assess air quality problems at a given point in time, while their opinions change over time. A similar conclusion can be drawn when analyzing the evaluations of actions taken to ensure air quality. For this reason, it was interesting to learn what actions Europeans expect to reduce air pollution (Table 3).

Table 3. The most effective ways of tackling problems of air quality

Issues	2012				2019			
	Y1	Y2	BB1	BB2	Y1	Y2	BB1	BB2
Applying stricter pollution controls on industrial and energy production activities	40.5	45.8	45.5	42.6	40.6	44.1	45.4	46.3
Applying stricter controls on emissions from new cars and trucks	28.8	26.4	25.8	28.7	26.4	26.1	23.6	24.4
Restricting traffic in polluted cities	38.8	25.7	26.2	28.7	21.9	19.0	18.5	18.9
Providing more information to the public on the health and environmental consequences of air pollution	41.1	37.2	33.7	31.8	26.2	21.5	23.8	24.0
Providing higher financial incentives for low emitting products	29.5	39.9	37.0	31.0	29.2	29.2	28.4	24.2
Ensuring better enforcement of existing air quality legislation	15.7	17.1	18.4	18.1	25.8	23.0	25.7	25.0
Introducing stricter air quality legislation	23.3	18.9	17.3	19.2	26.0	25.4	26.8	29.1
Increasing taxation on air-polluting activities	17.2	20.5	17.8	15.2	21.5	23.8	20.9	20.4

Source: Own elaboration.

Regardless of age, in 2012 Europeans most often indicated pollution controls on industrial and energy production activities as the best ways to reduce air pollution (Table 3). Next: better information systems about the consequences of air pollution for health and environment and higher financial incentives for low emitting products. In 2019, the most effective way to reduce air pollution is the same as in 2012. Other ways of coping with air pollution were also assessed very similarly. In 2012, three factors were selected more often than in 2019: restricting traffic in polluted cities; better information systems about the consequences of air pollution and higher financial incentives for low emitting products.

Conclusions and Discussion

Air pollution is a serious problem due to its character and the effects it has on the natural environment. Air pollution is all emissions to the air, both natural and anthropogenic (much more dangerous and dominant). As indicated by Mukhtarova *et al.* (2018) “each of these pollutants has its own specifics in terms of impact on public health”. The problem of air pollution is very complex due to the relationship between all random factors and subsequent direct and indirect effects. It should also be remembered that air pollution can be felt at a considerable distance from the place of its emission (UN 1987). Olabe (September 2015, p. 22) points out that „the negative consequences are felt by societies everywhere".

However, in order to prevent further emissions of pollutants into the air, it is important to learn about subjective opinions on air pollution problems, activities undertaken to ensure high air quality as well as actions taken in this regard by decision-making bodies. Data related to subjective perceptions of air quality should be collected frequently and in complicity with the socio-economic factors that describe individuals. The assessment of air quality and the willingness to deal with this problem result from the current perception of individual well-being. It must not be forgotten that quality of life is related to a specific moment in life and therefore a temporary context, expectations, relationships, social position, and a sense of participation and inclusion play an important role here (Stanimir 2020). Among the factors most related to an individual's well-being are water-holding capacity, reduction of warming potential, resistance and resilience to climate change (Stanimir 2020), which are inextricably linked to air pollution. Green-growth, which is the opposite of air pollution, is a straight path to "substantial economy, social and economic benefits for societies and enable synergies between them" (GGBP July 2014, p. 12). Air quality continues to deteriorate in low- and middle-income countries, especially where urbanization is intense and energy comes from burning fossil fuels. Richer countries have a better chance to fight air pollution. However, due to the inability to stop the movement of air pollutants, a synergy of actions in all countries is necessary.

In this study, subjective evaluations of various air pollution related effects and activities were analyzed. The views of Europeans from the two generations Y and BB in the two years 2012 and 2019 were analyzed. The aim of the study was achieved. We have obtained confirmation that the BB and Y generations of Europeans do not differ significantly in their assessment of the current problems related to air pollution. However, they change their views over time. In this case, an in-depth analysis would be necessary. It should focus on the change in the amount of comprehensible information reaching the society and the intensity of our own search for air pollution information as well as on individual prevention. Another goal of the study was to check whether the generations have the same assessment of actions taken by various entities to reduce air pollution. In this case, the analysis showed both a large differentiation in the assessments made by generations in the same period of time as well as the differentiation of assessments within the age group after 7 years compared to the base period (2012).

The Eurobarometer survey in 2012 and 2019 collected information on the most frequently undertaken (over the last 2 years) activities to reduce harmful emissions (X8). It wasn't surprising that young people were more likely to use public transport and bicycles than those in the BB group. Whereas, older people more often than people from Y generation indicated changing the housing heating system from higher-emitting to lower-emitting or buying a low emission car. It is related to the financial situation of the household and the type of home ownership. An analysis of air quality friendly behavior would be very interesting, but it requires additional data (not available in the Eurobarometer) on the financial situation of the household, the type of home ownership, access to public transport, *etc*.

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