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Tourism and Air Quality during COVID-19 Pandemic: Lessons for the Future

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Abstract: The pandemic caused by coronavirus SARS-CoV-2 (associated to the disease named COVID-19) is having a global impact that affects health, the economy and the environment. These impacts are negative in most of the sectors but benefits also occurred in specific fields. Tourism was one of the most negatively affected economic sectors, and in terms of benefits, the improvement of air quality can be highlighted, with positive health implications. This paper aims to evaluate the impacts on these two particular fields—tourism and air quality—focusing on Portugal due to the relevance of tourism in the country. The research carried out in this paper enables us to find the most critical areas and identifies lessons learnt and recommendations for the post-COVID period. Tourism and air quality data were collected for both 2019 and 2020 and compared in terms of quantitative and spatial analysis. The Lisbon metropolitan area—the geographical area where the capital of the country is located—was the area that suffered the most negative impacts in terms of tourism activity but was also the one where highest benefits in terms of air pollution reduction and human exposure were felt. Recommendations for future strategies are suggested, including new concepts of tourism connected to the environment; the investment in online/virtual tourism activities; promotion of the domestic market; mitigation of the over-tourism problem and using environmental issues, such as air quality, as new attractiveness criteria for tourism destinations.

Keywords: COVID-19; air pollution; tourism; health Portugal; future recommendations

1. Introduction

The emergence of the COVID-19 pandemic had a severe impact on peoples' daily lives, not only affecting human health but also several other domains. Mobility restrictions were imposed all around the world to reduce the spread of the virus.

An unexpected worldwide economic recession with strong negative implications on all economic sectors is happening. According to the Organisation for Economic Co-operation and Development (OECD) [1], the share of businesses shut down due to containment measures during COVID-19 crisis—including countries like Belgium, Canada, Ireland, Portugal and United Kingdom—highlighted that the most affected sectors were "accommodation and food services" together with "arts, entertainment and recreation". There is evidence that tourism has been one of the industries most affected by COVID-19 [2]. This pandemic profoundly changed the evolution trends of tourism, both due to the strategies adopted to prevent the spread of the disease, such as lockdown measures and border closures [3], people's fear of taking risks by traveling [4], or even due to the decrease in the purchasing power of the population [2,5,6]. This scenario not only provoked a decline in tourism demand, but also posed many challenges to companies in the tourism industry [3,4,7]. However, despite the recent character of this disease and the relevance of understanding the impact of COVID-19 on tourism, the research on this effect is still scarce. Nevertheless, some researchers have already reflected on this and provided valuable insight into this issue. As far as the geographical context is concerned, some studies have a global overview, or at least of several countries [4,8–12], where others focus on a specific country—e.g., Bangladesh [7], Malaysia [13,14] and Greece [15]—or on specific regions—e.g., the People's Republic of China and Asian countries [16]. Despite most of the research encompassing the tourism industry as a whole, some of the existing studies concentrate on a specific part of this industry such as airline companies, e.g., [17,18], with a dramatic decrease in international tourist arrivals and flights being noticed [7,9,11,13,19]. In particular, the number of international passengers decreased 60% in comparison to 2019, which led to an overall loss of USD 370 billion in the aviation sector [20]. Another concern is the decline on the occupancy rate of some facilities such as hotels, which sometimes led to bankruptcy and closure of some businesses [7,9,13]. Most hotels were closed or had a substantially lower numbers of guests, although domestic markets can be anticipated to recover first [11]. Moreover, restaurants have also been very affected by the pandemic. The strategy of social distancing to manage COVID-19 adopted in many countries for several months led to many problems in restaurants recovering, specifically as they usually have limited liquidity and small profit margins [10]. Where restaurants were allowed to stay open for take-away customers, this was an operational alternative, also requiring fewer staff. Many small places, including cafes, may have decided to stay closed [11]. Meetings, incentives, conferences and exhibitions (MICE) and sports events were also affected. All forms of events in which large groups of people meet were restricted, such as concerts, meetings, conferences, sports, or large family gatherings. Major sports leagues across Europe, North America and other regions have all ended their seasons and cancelled the opening of others including the postponed 2020 Summer Olympic Games or the UEFA EURO 2020. The combined economic impact is not yet known but will be in the hundreds of billions of US dollars [11].

At the macro level, due to the consequences of the pandemic on tourism, global GDP is expected to decline 1.5% to 2.8%, while more than 100 million jobs are at risk, and small businesses (which shoulder 80% of global tourism) are particularly vulnerable [21]. Service-oriented economies will be negatively affected, especially countries such as Greece, Portugal, and Spain, which are more reliant on tourism (tourism accounts for more than 15% of GDP) [10]. Most of the mentioned touristic destinations were recovering from the last financial and economic crisis (Portugal and Greece, for example, had the TROIKA intervention and were recovering, mainly using tourism sector revenues, which represents the highest percentage of economic growth of both countries). According to a recovery model proposed by McKinsey [22], for the recovery of the sector, a cumulative drop of USD 3 to USD 8 billion is expected until tourism spending returns to pre-COVID-19 levels, something that can only occur in 2024. The recovery will be slow and driven by the dependence that each country had on domestic travel and air transport. As a result, each country must prepare for its own pace of recovery and seek to reinvent/reshape its tourism sector. Additionally, the World Tourism Organization (UNTWO) [21] foresees the return of tourism to pre-COVID numbers only in 2023 or 2024. Travel restrictions are seen as the main barrier to the recovery of international tourism, along with slow containment of the virus and low consumer confidence. The lack of a coordinated response between countries to guarantee harmonized protocols and coordinated restrictions, as well as the deterioration of the economic environment, are other reasons cited.

The pandemic caused, and still causes, several economic downturns [10], but in contrast it clearly allowed for a reduction in pollution levels, mostly due to imposed mobility restrictions, especially those related to travelling [23–25]. Fossil fuels are still the main source of energy for intensive economic activities like industry and transportation. However, they represent the major cause of global emissions through the emission of various harmful gases. Therefore, there is a dual effect here. On the one hand, COVID-19 greatly harms economic growth and imposes negative social conditions (lower supply and demand of products, decreased income, closure of establishments and industries, lower profits, savings and investments, more unemployment and its deep social impacts, etc.). On the other hand, it helps improve the sustainability of the world in terms of environment and health (increased health, lower pollution, less harmful production processes, lower harmful touristic activities, etc.). Thus, the pros and cons of economic growth decrease due to the pandemic must be carefully weighed against the environmental benefits it brought.

Despite all the immediate negative effects of the pandemic on the human health and societal daily routines and activities, the imposed mobility restrictions led to positive indirect effects on the environment, mostly in urban areas, e.g., [26]. More than 80% of people living in urban areas that monitor air pollution are exposed to air quality levels that exceed the World Health Organization (WHO) limits. Lockdown measures are associated with a reduction in noise in the cities and improvements in urban air quality, e.g., [27–30], which may also be related to specific health benefits, e.g., [18,31,32].

Despite the observed reduction in the majority of air pollutants during the lockdown, some pollutants increased, such as the ozone [33,34]. It was also verified by some studies that the reduction in air pollutants concentration is short-term. For instance, between 50 and 70% of the air quality benefits observed while in lockdown had already been offset by the return of vehicles to the roads [23,24].

Besides various other past episodes demonstrating that economic sectors like tourism are resilient activities [5], this global pandemic can be an excellent opportunity to reinvent the tourism sector, to be innovative and transformative and to be an effective instrument of sustainable development, rather than to return to business-as-usual when the crisis ends. There is a chance to rethink the tourism industry, changing behaviors and mental awareness about the environment–tourism relationship. More than ever, sustainability is a key issue for the development of strategic approaches within the tourism sector [35], being strongly related to tourism destinations competitiveness [36,37], and thus emphasizing the urgency to shift the traditional tourism development paradigms. Although it is often argued that environmental sustainability is a great contributor for tourism growth, there are different perspectives concerning the influence of sustainability on visitors' behaviors in choosing sustainable destinations [35,38]. For instance, Dodds et al. [39] found that visitors are concerned with a destination's sustainability and engage into practices to protect the environment. Even so, visitors are becoming more environmentally sensitive [40] and particular aspects of a tourism destination, such as air quality, are starting to influence the destination's attractiveness [41].

This paper aims to assess COVID-19 pandemic effects on both tourism and air quality, two sides of the COVID coin, with Portugal as a case study. This assessment will allow the identification of the most affected areas, quantifying the economic losses in the tourism activity sector, as well as estimating human health impacts and benefits resulting from the improvement in air quality. Based on this analysis and lessons learned, the study carried out in this paper aims at contributing to the ongoing discussion for a sustainable post-COVID future regarding tourism and environmental sectors.

The paper is organized as follows: Section 2 presents an overview of the COVID-19 pandemic evolution in Portugal during the period between January and September of 2020. Section 3 focuses on the impacts on the tourism sector, based on official statistical data and descriptive analyses, comparing the performance of tourism activity during the first three quarters of 2020 with the homologous period of 2019. In Section 4, the impact on air quality, together with its impacts on human health and benefit analysis is presented. Finally, in Section 5, lessons learned and future reflections are discussed.

2. The Evolution of COVID Pandemic in Portugal

The first infections by COVID-19 in Portugal were reported on 3 March 2020 (see Figure 1). The evolution of the total confirmed cases in the initial phase was relatively low, with an average daily growth of 257 cases which lead to a total of 6.2 cases per 10 thousand inhabitants at the end of March. Despite this evolution, April registered the highest number of daily cases during the period in analysis, reaching maximums of 5.2 and 5.1 new cases per 10 thousand inhabitants in the first half of the month, and totaling more than 23 confirmed cases per 10 thousand inhabitants at the end of the month. Due to the effective response of the Portuguese authorities, the spread of the coronavirus was restrained in the following period, with a significant decrease in new cases until the end of May and stabilization during June and July. Particularly, the implementation of travel restrictions to and from countries with extreme epidemic conditions (e.g., Italy, Spain) and the limitation of recreational activities (e.g., sports practice, family and friends' gatherings) combined with supplementary confinement measures, were crucial to avoid an exponential growth of people infected by COVID-19. The efficiency of these strategies led both European and International governments and entities to praise Portugal and to recognize the country as an interesting case study. August registered a reasonable decrease in comparison with the previous months, but the consecutive actions to ease the measures imposed earlier, together with the start of the academic year and return to in person classes, led to a considerable and gradual growth of new infections in the next months. Concerning the mortality due to COVID-19, the first death was reported fifteen days after the appearance of the initial cases. Its evolution was significantly higher during April, starting to stabilize over time, specifically since June. With an average of 9.3 deaths per day, Portugal registered a total of 1971 deaths by the new coronavirus at the end of September, representing 2.6% of the total confirmed infections (75, 542) [42].

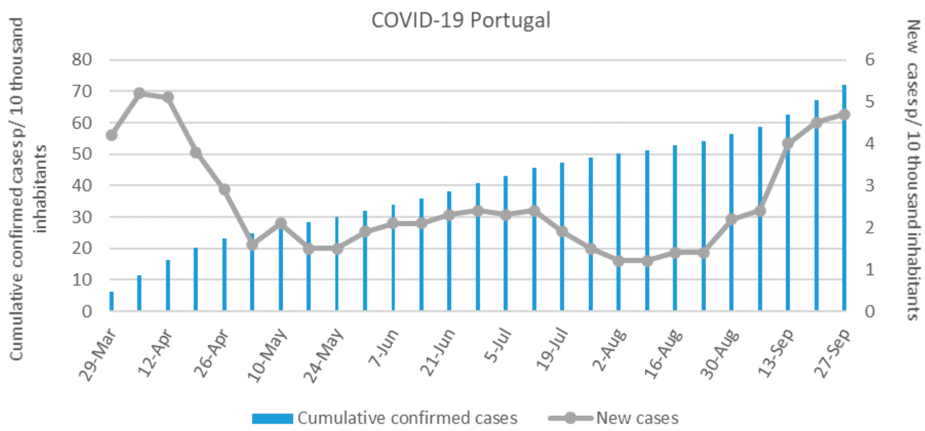

Figure 1. Weekly new and cumulative confirmed cases per 10 thousand inhabitants in Portugal [42].

At a regional scale (Figure 2), the North region reported the majority of new infections in the first two months, with an average of 7.16 new cases per 10 thousand inhabitants, partially explaining the prompt spread of the virus during that period. The Lisbon region was the second with a higher incidence rate with an average of 2.94 new infections. In contrast with the North region, where the number of infections significantly decreased and stabilized until September, the Lisbon region reported a gradual growth of new cases, which reached a maximum of 7.6 new confirmed cases per 10 thousand inhabitants in mid-July. On the opposite side, Alentejo, Azores, and Madeira were the regions with less new infections and, consequently, registering the lowest number of confirmed cases at the end of the period. In the middle of March, the government of Azores implemented a set of restrictions to those arriving in the archipelago (first imposing a quarantine period of 14 days and afterwards requiring a negative result for COVID-19 as a condition to guarantee their entrance in the region). A similar procedure was adopted in Madeira. These measures might have made a crucial contribution to the reduced numbers of cases in both regions.

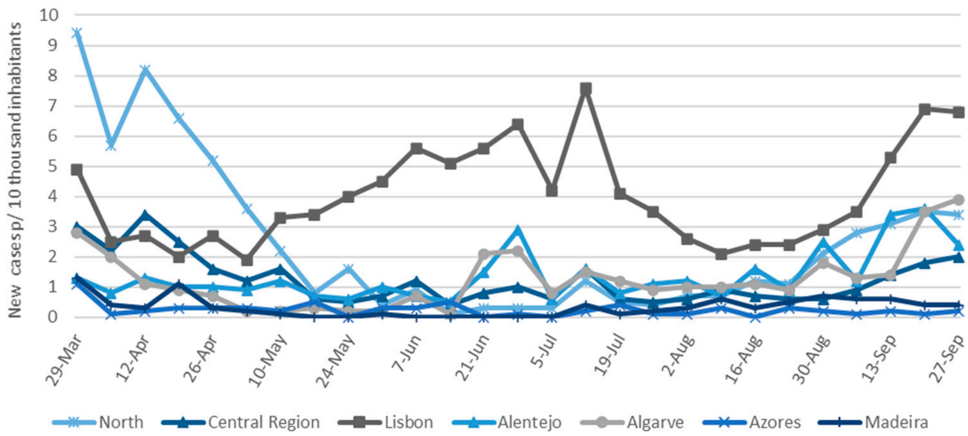

Figure 2. Weekly new confirmed cases per 10 thousand inhabitants by regional territorial units (NUTS—Nomenclature of Territorial Units for Statistics II) [42].

Concerning the distribution of deaths (Figure 3), the North and Lisbon regions represented almost 85% of the total deaths from COVID-19. The most critical period with the highest number of daily deaths occurred between March and April, with Lisbon also presenting a high rate during July. In contrast, Azores was the region with the smallest number of deaths (15), while Madeira did not present a single death during the period of analysis. No deaths were registered during January and February, once the first cases of COVID-19 were registered in March.

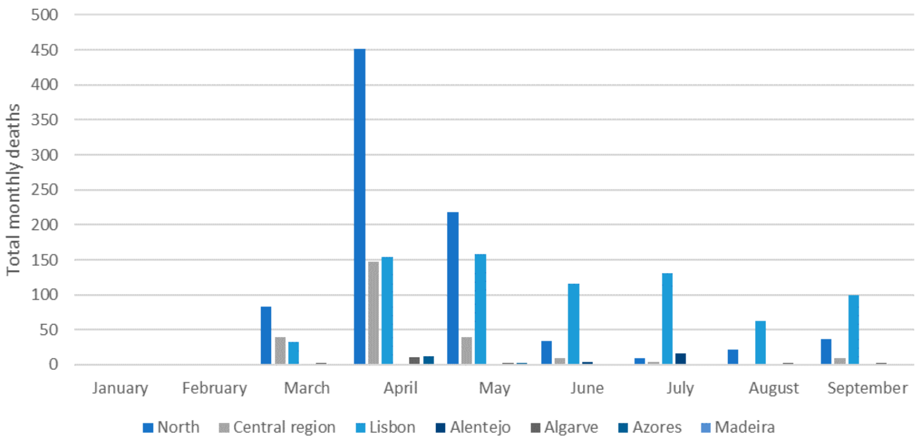

Figure 3. Monthly confirmed deaths by regional territorial units (NUTS II) [42].

A more detailed analysis of the weekly numbers of new infections and total cases per 10 thousand in the three municipalities with the highest tourism activity: Lisbon (where the Portuguese capital is located), Albufeira and Portimão (in Algarve, which are two important tourism destinations recognized worldwide) (Figure 4) allows us to observe that the municipality of Lisbon registered higher records for both indicators, with the most critical periods occurring in March, mid-July, and September, where a gradual growth of new infections until the end of the month is also noticeable. Despite two critical periods at the end of March and June, where a peak of 4 new cases per 10 thousand inhabitants is observed, Portimão maintained a controlled evolution of the pandemic. A similar pattern is visible in the case of Albufeira although with higher values, particularly during April and September. Additionally, a contraction of new infections during August led to a narrow difference between the three municipalities, in contrast with the scenario registered within the rest of the period in analysis. The discrepancy observed between March and September explains the significant difference concerning the cumulative cases, with Portimão registering almost 30 cases per 10 thousand inhabitants, while Albufeira surpassed the 60 infections and Lisbon registered 125 infections.

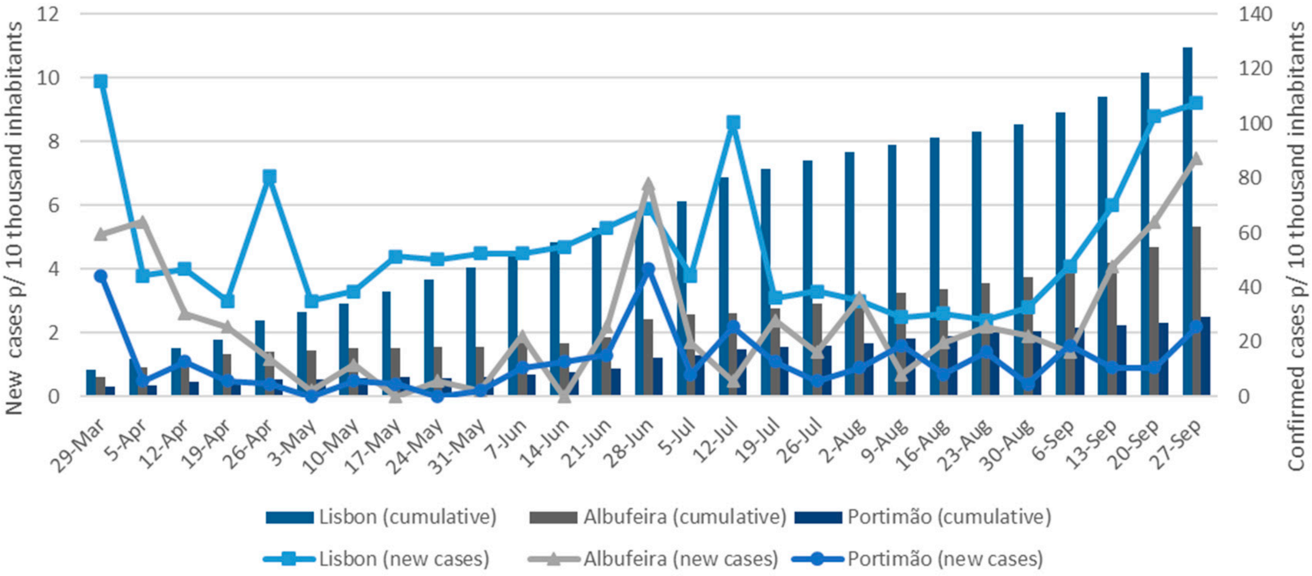

Figure 4. Weekly new confirmed cases and cumulative confirmed cases per 10 thousand inhabitants by municipality [42].

3. Impact of COVID-19 on Tourism Activity

The last two decades represented a noteworthy growth in the Portuguese tourism sector. The real impact started to be felt after 2012, in a context of economic recovery and financial assistance by international institutions. After that period, the Portuguese tourism sector faced a new paradigm. From 2012 to 2019, the number of international arrivals grew at an average annual rate of 7.4%, in comparison to an average growth of 1.3% (2000–2011) before the economic and financial assistance program [43]. Consequently, the number of overnights was almost two times higher in 2019 than it was at the beginning of the decade. Thus, Portugal ranked 15th concerning the number of international arrivals and 20th regarding the international receipts [44], a positive performance that granted the country the title of World's Leading Destination [45] for three years in a row (2017 to 2019), revealing the preponderance of the tourism sector for Portuguese economic activity. Within this scenario, it is fair to state that the tourism sector plays a central role in the national economic structure, contributing up to 16.5% of the total GDP and almost 19% to employment [46], including direct, indirect and induced effects, while the most recent data from 2018 reveal a direct contribution of 8% from tourism activities to the national gross value added [47].

However, in 2020, this scenario of growth changed completely. The impact of the COVID-19 on Portuguese tourism industry has been devasting. As understandable by the evolution of the travel demand in Portugal (Table 1), specifically of overnights in tourist accommodation establishments, the fall was significantly higher during April and May, followed by a recovery in the third quarter of 2020, although with a strong negative variation when compared to the homologous period of 2019. This was an unexpected decline, since the two first months of the year registered an interesting growth when compared to the homologous period of 2019. Furthermore, Table 1 also shows that the catastrophic impacts of COVID-19 were softened by the domestic market, despite its negative performance.

Besides the negative effects of COVID-19 on people's willingness to engage in tourism trips [48], supported by the evidence that countries exposed to high international tourism flows are more prone to COVID-19 cases and deaths [8], several additional national and international policies restricting tourists' flows might have contributed to the decline of tourism demand in Portugal (both domestic and international) (Figure 5). Specifically, the suspension of international flights from non-EU countries, in March, was the first joint measure limiting the transit flows to and from outside EU borders. Later, other measures were implemented by specific countries (e.g., imposed quarantine period or even suspension of outbound travel from Belgium and Germany) that directly affected the decrease in international arrivals. One of the most critical was the exclusion of Portugal from the United Kingdom's safe travel corridor, during July and mid-August, which resulted in losses of 86% in overnights from UK tourists. Additionally, during Easter (a high season for some Portuguese destinations) and on the Labor Day holiday the government prohibited inter-municipal circulation, with direct consequences for tourism, especially for the domestic market.

Table 1. Total overnights in tourist accommodation establishments in Portugal, by origin [43].

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Total Overnights	2019	3,019,760	3,344,806	4,598,754	5,946,820	6,496,709	7,152,704	8,181,624	9,561,062	7,624,574
	2020	3,253,096	3,838,559	1,900,128	155,012	276,508	1,041,233	2,648,164	5,092,842	3,551,658
	% Δ	7.7	14.8	−43.2	−97.4	−95.7	−85.4	−67.6	−46.7	−53.4
Domestic	2019	962,386	1,033,024	1,353,421	1,678,240	1,621,879	2,144,269	2,502,090	3,412,179	2,220,480
	2020	1,075,595	1,307,452	566,483	108,280	217,309	876,997	1,771,091	3,384,308	2,032,350
	% Δ	11.8	26.6	−45.2	−93.5	−86.6	−59.1	−29.2	−0.8	−8.5
International	2019	2,057,374	2,311,782	3,245,333	4,268,580	4,874,830	5,008,435	5,679,534	6,148,883	5,404,094
	2020	2,177,501	2,531,107	1,333,645	46,732	59,199	164,236	877,073	1,708,534	1,519,308
	% Δ	5.8	9.5	−42.3	−98.9	−98.8	−96.7	−84.6	−72.2	−71.9

Δ—homologous variation.

The positive response and the minor cases of COVID-19 during the Summer season were an opportunity to develop some actions to re-open tourism activities. Besides the gradual lift of travel restrictions to specific countries, other measures were put into practice. Apart from the obligation to use a mask on public transportation and to guarantee a safe distance from third parties, the most relevant one was the Clean and Safe stamp [49], with the main objective of recognizing tourism companies complying with the National Health Authority guidelines on how to avoid risks of contagion of COVID-19. Furthermore, it also intended to stimulate the demand by providing a sense of security for visitors. As a consequence, Portugal was the first European destination to guarantee the Safe Travels stamp [50] granted by the World Travel and Tourism Council (WTTC) to those destinations following the health and hygiene protocols, as a way to mitigate the negative effects of the pandemic over the tourism sector. To better comprehend the impact of this successive measures, the University of Oxford developed the Oxford COVID-19 Government Response Tracker [57] aiming to provide updated data (stringency index) related to national governments' responsive measures to prevent the spread of COVID-19. More precisely, the index integrates a total of nineteen policy measures divided into three main areas: *containment and closure* (e.g., restrictions on internal movement, international travel bans, event cancellation, general lockdowns); *economic response* (e.g., income and fiscal support); and *health systems* (e.g., protective masks, information campaigns, testing policy). Figure 6 provides an adapted overview concerning the measures' strictness evolution during the period in analysis, based on a monthly mean of the stringency index to Portugal. As observed, the period with the major stringency index (April and May) corresponds to the period with higher tourism losses (Table 1), while the slight recovery of tourism demand was accompanied by a relief of restrictive measures, establishing and supporting the existence of a potential direct relationship between government policies and the evolution of tourism dynamics. Then, as the number of infections was decreasing, the measures' strictness also begun to be relived.

Measures	2020
First cases of COVID-19 in Portugal	March 2
Landing ban for all international cruise ships	Since March 14
Suspension of all flights to and from Italy	From March 11 to June 15
Suspension of international flights from non EU countries to the EU region	From March 17 to June 30
Suspension of international flights (non EU countries) to and from Portugal	Since March 17
Decreed the state of emergency in Portugal	From March 20 to May 2
Reduction of the number of passengers in the aviation sector	From April 8 to May 25
Prohibited the circulation of people outside the municipality of residence	From April 9 to April 13
Turismo de Portugal launched the *Clean & Safe* stamp	April 24
Germany suspended all international flights to and from the country	From May 15 to June 15
WTTC granted the *Safe Travels* stamp to Portugal	June 8
Implementation of special contigency measures in Lisbon (e.g. mobility restrictions)	From June 22 to July 31
United Kingdom excluded Portugal from the safe travel corridor	From July 3 to August 21
Ireland imposed a quarantine period to passengers arriving from Portugal	Since July 22
Portugal included in the safe travel corridor of the United Kingdom	From August 22 to September 11
United Kingdom excluded Portugal from the safe travel corridor	Since September 12
The Netherlands imposed a quarantine period to passengers who visited Portugal	Since September 15

Figure 5. International and national measures with direct and indirect impacts on tourism activity in Portugal [49–56].

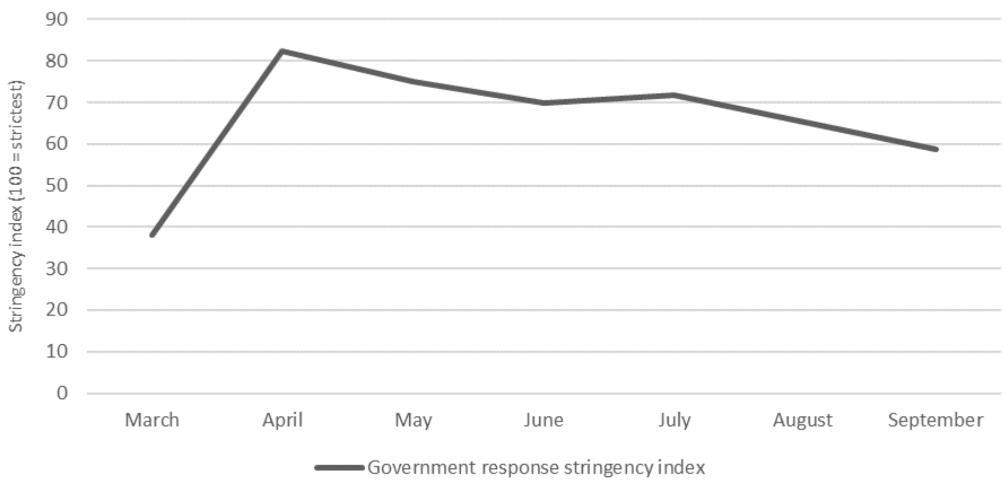

Figure 6. Portugal's COVID-19 stringency index [57].

To further examine the implications of these measures in the tourism sector, a Spearman's correlation coefficient was used to analyze if there was a statistically significant association between the Portuguese government response stringency index and the total overnights on tourism accommodation units. The results revealed the existence of a negative statistically significant association between the two variables (coefficient = −0.686; p-value = 0.041), meaning that strict policies lead to a decrease in the total overnights in the accommodation establishments.

3.1. Analysis per Region

Table 2 highlights the differences found for the different Portuguese regions regarding the impact of COVID-19 on the revenue of tourism accommodation units. Alentejo, Central region, and the Azores were the tourism regions with better performance at the beginning of 2020, regarding the total revenue in tourist accommodation establishments. The effect of pandemic restrictions on the tourism industry had slight differences among these tourism regions. During this period, the losses were significant, starting to soften in June, although with major expression since July. Nevertheless, regions such as Lisbon, Madeira, and the Azores still reported high negative variations along the entire summer season, justified with a set of punctual policies applied in each territory. In the case of Lisbon, the significant increase in new daily infections justified the implementation of special measures from 22 June to the end of July, such as the limitation of circulation in the streets. On the other hand, Madeira and Azores implemented strict control measures to those arriving at the islands, which might have inhibited travelers' will to visit both regions. A careful analysis of Table 2 shows that Lisbon was the region with major losses, while Alentejo positioned on the opposite side. Interestingly, both the North, the Central region, and Alentejo surpassed the total revenue registered in Lisbon during June, with a similar trend in July. This shows how dramatic the pandemic was in the tourism dynamics of Lisbon. Comparing with the results of 2019, it is rapidly understood that Lisbon was positioned as the second most important tourism destination in Portugal concerning total accommodation revenue, sometimes doubling, tripling or even quadrupling the results reported in the other three regions. Still, the significant increase in new daily cases, specifically since June, and the above-mentioned special measures implemented in the region caused this inverse scenario. Additionally, this might have happened due to a diversified offer and increased demand, mainly domestic, for rural and nature experiences in the North, the Central region and Alentejo, which Lisbon region is not capable to support. This situation was also registered by Vaishar & Šťastná (2020) [58] regarding the effects of COVID-19 on rural tourism in the Czech Republic, where a market opportunity for the development of rural tourism, supported by domestic tourists, was identified.

After a slight recovery, tourism demand declined in September, with major losses being reported in the Mainland regions of Portugal. This may be justified with the measures highlighted before, but also with the reduced number of COVID-19 cases in the autonomous regions of Madeira and Azores, which promoted the inclusion of both regions in the safe travel corridors of countries such as the United Kingdom and The Netherlands.

In order to analyze whether there was a statistically significant association between some indicators related to COVID-19, such as the number of deaths, and the total revenues in tourist accommodations, Spearman's correlation coefficient was used. The results described in Table 3 revealed the existence of a negative statistically significant association between the number of deaths per COVID and the total revenues for Portugal. The results also reveal that this association is more intense in the regions where the number of deaths associated with COVID was higher, namely in Lisbon, the North and Central regions. On the other hand, no statistically significant associations were observed in the regions where the number deaths were low, such as the Alentejo and Algarve regions. In the case of Madeira, this statistical test was not performed because no deaths occurred during the period under analysis.

Figure 7 provides an overall perspective of the losses in the total revenue in tourist accommodation establishments occurring between January and September of 2020 compared with the homologous period of 2019. As observed, the seven regions registered considerable losses, although with some differences. The results reveal that Lisbon and Algarve led the breaks, by far surpassing the value of −500 million euros. On the opposite side, Alentejo and Azores reported a minor decline on their income, both below −100 million euros.

Table 2. Total revenue in tourist accommodation establishments, by regional territorial units (NUTS II) (thousands of euros) [43].

		Jan	Feb	Ma	Apr	May	Jun	Jul	Aug	Sep
Portugal	2019	164,943	172,733	248,243	334,929	408,100	465,982	534,629	638,292	501,535
	2020	175,315	195,299	99,649	5083	10,152	53,422	161,200	326,463	204,791
	% Δ	6.3	13.1	−42.3	−98.5	−97.5	−88.5	−69.8	−48.9	−59.2
North	2019	27,270	28,311	38,200	50,906	63,013	67,675	70,105	82,392	58,288
	2020	31,265	32,433	13,644	1108	2678	10,872	25,503	46,303	30,978
	% Δ	14.6	14.6	−64.3	−97.8	−95.8	−83.9	−63.6	−43.8	−46.9
Central Region	2019	15,627	16,041	21,375	27,422	31,937	33,328	38,685	54,621	39,349
	2020	17,271	20,077	8024	683,1	1702	7749	19,152	39,507	22,855
	% Δ	10.5	25.2	−62.5	−97.5	−94.7	−76.7	−50.5	−27.7	−41.9
Lisbon	2019	65,497	65,837	96,951	116,906	144,973	145,869	133,939	138,527	147,509
	2020	68,431	70,349	33,464	2070	3083	7361	18,177	38,800	29,343
	% Δ	4.5	6.9	−65.5	−98.2	−97.9	−95.0	−86.4	−72.0	−80.1
Alentejo	2019	6282	6458	8679	13,046	15,005	18,102	22,752	31,941	21,038
	2020	7351	8683	3622	586.1	1576	8595	18,123	29,420	16,479
	% Δ	17.0	34.4	−58.3	−95.5	−89.5	−52.5	−20.3	−7.9	−21.7
Algarve	2019	22,218	27,760	45,415	84,815	103,192	147,560	208,937	265,061	164,951
	2020	22,473	32,682	22,076	537.3	1008	17,411	72,331	154,633	87,843
	% Δ	1.1	17.7	−51.4	−99.4	−99.0	−88.2	−65.4	−41.7	−46.7
Azores	2019	3206	3725	5610	8886	11,446	14,381	18,064	19,113	14,439
	2020	3595	4325	2586	7.5	25.3	579.7	2603	5771	4386
	% Δ	12.2	16.1	−53.9	−99.9	−99.8	−96.0	−85.6	−69.8	−69.6
Madeira	2019	24,843	24,600	32,014	32,949	38,534	39,068	42,147	46,635	40,428
	2020	24,929	26,750	16,233	91.0	80.5	528.2	5312	12,960	12,907
	% Δ	0.3	8.7	−49.3	−99.7	−99.8	−98.7	−87.4	−72.2	−68.1

Δ—homologous variation.

Table 3. Spearman's correlation between total deaths by COVID-19 and total revenue in tourist accommodation establishments, by regional territorial units (NUTS II).

			Total Revenues in Tourist Accommodation Establishments						
	Portugal and NUTs II	**Spearman's Correlation**	**Portugal**	**North**	**Central Region**	**Lisbon**	**Alentejo**	**Algarve**	**Azores**
Total Deaths by COVID-19	**Portugal**	Coefficient Sig. (2-tailed)	−0.845 ** 0.004						
	North	Coefficient Sig. (2-tailed)		−0.795 * 0.010					
	Central Region	Coefficient Sig. (2-tailed)			−0.700 * 0.036				
	Lisbon	Coefficient Sig. (2-tailed)				−0.946 ** 0.000			
	Alentejo	Coefficient Sig. (2-tailed)					0.470 0.202		
	Algarve	Coefficient Sig. (2-tailed)						−0.256 0.507	
	Azores	Coefficient Sig. (2-tailed)							−0.730 * 0.025

Note: *. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

3.2. Analysis per Municipality

At the municipal scale, a similar trend to that reported at the regional level can be identified (Table 4). In this particular case, the municipalities of Albufeira, Portimão and Lisbon are deeply analyzed due to their representativeness in the respective regional territorial unit (NUTS II—Algarve and Lisbon). In the case of Albufeira, where tourism demand starts to grow considerably during the Easter holidays, the effects of the pandemic completely changed the usual scenario. The beginning of 2020 accompanied the national growth tendency, registering an average growth of 11%, but the demand dropped to more than a half in March and was almost residual in the following months, with the total revenue registering values below 200 thousand euros during April and May. The sector started to slowly recover in June and this positive trend continued until August, in which the revenue of tourism establishments registered a total of 51 million euros. Even so, these results were only slightly more than half of those reported in 2019. A similar analysis was done on the case of Portimão, where the tourism revenue behaves identically. The example of Lisbon is somewhat different and becomes more interesting because the destination was suffering from overtourism in the last few years and faced a totally new reality during the pandemic period under analysis, which may provide some hints to the development of the destination in the short and long runs. Despite an identical evolution from March to August, the recovery of Lisbon's tourism sector was less pronounced. During the second quarter of 2020, the total accommodation revenue reported losses above 95% and even with a minor improvement in July and August the results were still catastrophic, leading several businesses to shut down their activity (temporarily or permanently).

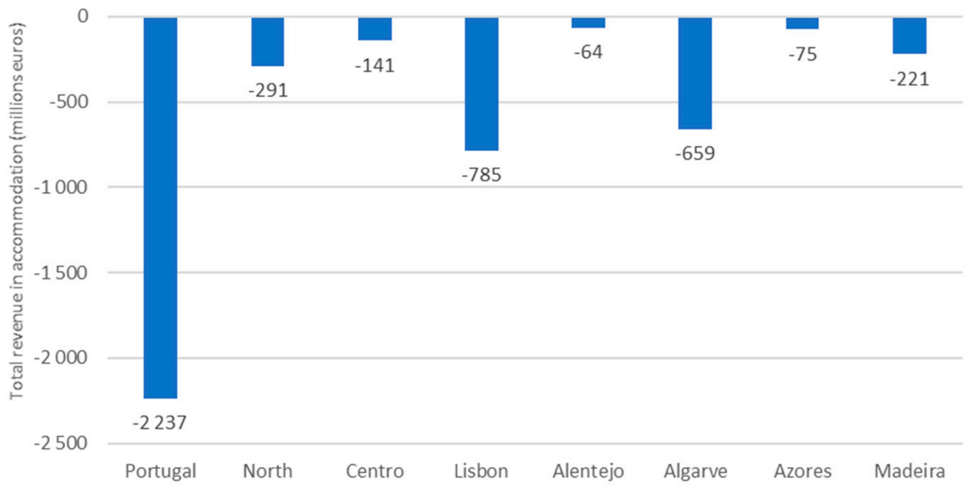

Figure 7. Accumulated losses in tourist accommodation establishments revenues, by NUTS II (million euros) [43].

Table 4. Total revenue in tourist accommodation establishments, by municipality (thousands of euros). [43].

		January	February	March	April	May	June	July	August	September
Albufeira	2019	5644	8274	15,835	31,559	37,648	53,717	76,316	94,602	58,856
	2020	5856	9821	7582	134.3	197.5	5124	23,735	51,054	30,394
	% Δ	3.7	18.7	−52.1	−99.6	−99.5	−90.5	−68.9	−46.0	−48.4
Portimão	2019	1766	2557	3990	8069	10,363	17,653	25,713	34,399	20,765
	2020	1842	3029	1616	112.3	163.6	1977	8454	17,669	10,380
	% Δ	4.3	18.5	−59.5	−98.6	−98.4	−88.8	−67.1	−48.6	−50.0
Lisbon	2019	51,790	51,395	77,100	90,758	111,404	109,992	95,381	94,287	109,820
	2020	54,271	54,147	26,134	1100	1621	3116	8055	17,660	16,699
	% Δ	4.8	5.4	−66.1	−98.8	−98.5	−97.2	−91.6	−81.3	−84.8

Regarding the cumulative revenue in tourist accommodation establishments, each of the destinations registered considerable losses. However, significant differences can be addressed. The revenues in the accommodation establishments of Lisbon reached more than 600 million euros of economic loss, while Portimão was the municipality with the minor decline, below 100 million euros (Figure 8). Concerning Albufeira, the results were also negative, reaching a cumulative decline of a quarter of a million euros.

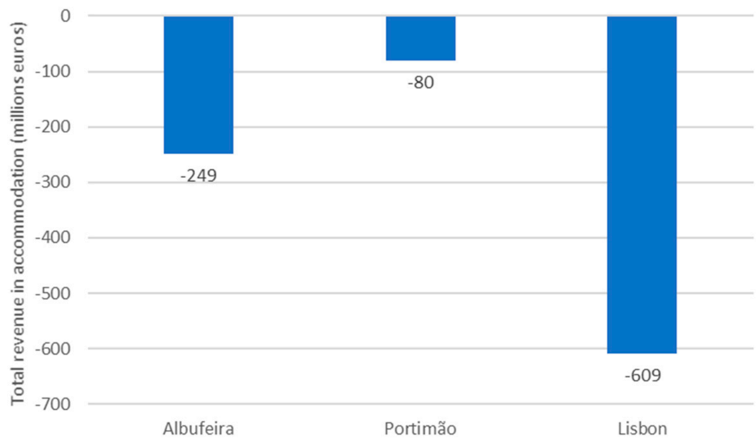

Figure 8. Accumulated losses in tourist accommodation establishments, by municipality (million euros) [43].

4. Impact of COVID-19 on Air Quality

4.1. Air Quality Improvement from the COVID-19 Lockdown

Previous studies have already demonstrated that at national level significative reductions in NO_2 and airborne particulate matter (PM)10 occurred due to the lockdown in Portugal, e.g., [29]. Those reductions were quantified, grouping data according to the classification of air quality monitoring stations (e.g., rural, urban background or urban traffic stations). At a national level, average reductions of 41% and 18% were observed for NO_2 and PM10 concentrations, respectively. For both pollutants, the highest reductions were observed in urban areas, particularly at urban traffic stations, where average reductions of 51% and 27% were observed for NO_2 and PM10, respectively. According to these results, the impact of the COVID lockdown was higher for NO_2 than for PM10. This happens because during the COVID-19 lockdown, due to movement restriction of the citizens, a significant reduction in mobility trends was observed, which can be used as a proxy for transport activity [29]. NO_2 is a direct-traffic pollutant while PM10 has other relevant sources besides road transport.

In this paper, the impact of the COVID-19 lockdown on air quality is assessed in detail for specific regions, which heavily depend on the tourism industry and that were highlighted in Section 3: Lisbon and Algarve. This assessment is done based on observations collected from the national air quality monitoring network (https://qualar.apambiente.pt, accessed on 18 January 2021). Since air quality is strongly influenced by meteorological conditions, exhibiting pronounced seasonal patterns [59], to minimize the influence of meteorological and seasonal variability in our results, the impact of COVID on air quality is assessed by comparing air quality data collected during the pandemic (2020), with mean data for the same period from the previous five years (2015–2019), following the methodology used in Gama et al. (2021) [29]. The analysis focuses on nitrogen dioxide (NO_2) and airborne particulate matter (PM10 and PM2.5), since these are the most critical pollutants in Portuguese urban areas, mainly associated with traffic, domestic and industrial sources [60].

Air quality monitoring stations located in the two areas—Lisbon (capital of Portugal) and Algarve (Albufeira, Portimão and Faro municipalities)—presenting 75% or more of available data during the study period, have been selected (see Table 5). For each region and pollutant, data from at least two monitoring stations—one urban traffic and one urban background—were used. While for Lisbon all the selected monitoring stations are located within the same municipality, for Algarve it was necessary to use data from monitoring stations located in two different municipalities. To obtain a unique time series for Lisbon and another one for Algarve, data were grouped by region. Figure 9 presents the timeseries of spatially averaged NO_2, PM10 and PM2.5 daily concentrations observed from 1 January to 30 September of 2015–2019 and 2020 and calculated based on the hourly time-series collected in the Qualar database (https://qualar.apambiente.pt, accessed on 18 January 2021) for each pollutant and each monitoring site.

Table 5. Selected air quality monitoring stations.

Air Quality Monitoring Station	Municipality	Classification	Pollutants with More Than 75% Data
Avenida da Liberdade	Lisbon	Urban traffic	NO_2, PM10
Beato	Lisbon	Urban background	NO_2
Entrecampos	Lisbon	Urban traffic	NO_2, PM10, PM2.5
Olivais	Lisbon	Urban background	NO_2, PM10, PM2.5
Restelo	Lisbon	Urban background	NO_2
Santa Cruz de Benfica	Lisbon	Urban traffic	NO_2, PM10
David Neto	Portimão (Algarve)	Urban traffic	NO_2, PM10, PM2.5
Malpique	Albufeira (Algarve)	Urban background	PM10
Joaquim Magalhães	Faro (Algarve)	Urban background	NO_2, PM2.5

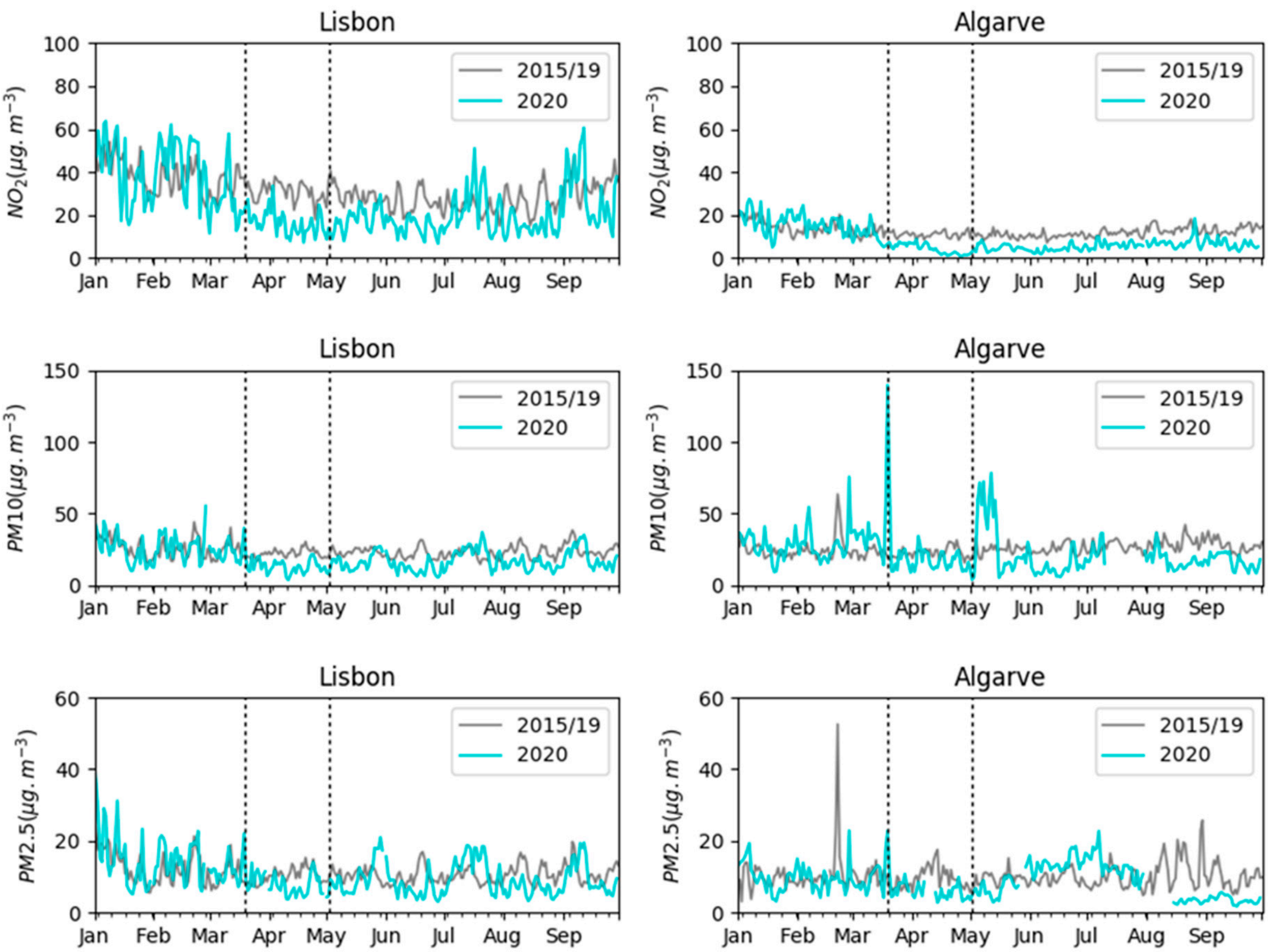

Figure 9. Timeseries of mean NO_2, airborne particulate matter (PM)10, and PM2.5 daily concentrations, for Lisbon and Algarve, observed from 1 January to 30 September 2020, and for the same period of the previous five years (2015–2019). Dashed lines identify the beginning and end of the State of Emergency.

The concentrations of NO_2, PM10 and PM2.5 in the atmosphere, from January to the middle of March, show similar values between 2020 and the reference period 2015–2019 (see Figure 9). With the population mobility restrictions imposed by the government during the State of Emergency, pollutants' concentrations decreased, especially for NO_2, which is a well-known pollutant emitted by the transport, energy, and manufacturing industries sectors. The mean reductions in NO_2 concentrations during the State of Emergency (obtained by comparison of 2020 with the reference period 2015–2019) are about 14 $\mu g \cdot m^{-3}$ (corresponding to 47%) for Lisbon and 7 $\mu g \cdot m^{-3}$ (corresponding to 61%) for Algarve. Despite the gradual restarting of anthropogenic activities after the end of the State of Emergency, NO_2 concentrations continue to exhibit lower values in 2020 compared to the reference period, both in Algarve and Lisbon (where July is an exception).

The reductions observed for PM10 and PM2.5 are lower than for NO_2. This behavior is also seen in many European urban areas, e.g., [61]. In Lisbon, average reductions of about 9 $\mu g \cdot m^{-3}$ (corresponding to 39%) and 2 $\mu g \cdot m^{-3}$ (corresponding to 20%) are observed for PM10 and PM2.5, respectively, during the State of Emergency (obtained by comparison of 2020 with the reference period 2015–2019). In Algarve, the several peaks registered, in the PM10 and PM2.5 timeseries, both for 2020 and the reference period, are mostly linked with desert dust episodes, which may severely impact air quality in the south of the Iberian Peninsula. Right after the beginning of the State of Emergency (around the 19th of March), for example, a strong desert dust episode occurred leading to PM10 daily mean concentrations higher than 100 $\mu g \cdot m^{-3}$, which is twice the daily limit value defined in the Air Quality Directive for the protection of the human health. In this region, to remove the influence of this specific episode that could lead to misinterpretation of the results, PM reductions were calculated from 21 March onwards, until the end of the State of Emergency period. Average reductions of about 6 $\mu g \cdot m^{-3}$ (corresponding to 27%) and 4 $\mu g \cdot m^{-3}$ (corresponding to 38%) are obtained for PM10 and PM2.5, respectively, by comparison of 2020 with the reference period 2015–2019.

4.2. Air Quality Impacts on Human Health and Cost–Benefit Analysis

The reductions observed in the different pollutant's concentrations can be translated in terms of benefits for health. During the last few decades, numerous epidemiological and toxicological studies reported a wide range of adverse health effects associated with short-term (hours, days) and long-term (months, years) exposure to air pollution (mainly PM10 and PM2.5) [62,63].

Simple health indicators such as mortality and morbidity, or combined indicators, such as attributable burden of disease measures or monetary costs, are used to estimate the impact of air pollutants on health. The selection of indicators depends on the stressor studied, availability of data, skills, computer resources, and purpose of the study [64]. Usually, the choice is made to show the potential policy action or inaction impact.

In this study, the comprehensive assessment of health impacts derived from air pollution was quantified using the AirQ+ tool (version 2.0), developed by the WHO [61]. The AirQ+ software is designed to calculate the magnitude of health impacts due to short and long-term exposures to outdoor air pollution from several pollutants (namely PM2.5, PM10, NO_2, O_3) using methodologies and concentration–response functions well established by epidemiological studies [62,63,65]. The analysis was based on the comparison of NO_2 and PM2.5 concentrations from 1 January to 30 September of 2020 and equivalent periods (in 2015–2019), in Lisbon and Algarve.

For the estimation of the short-term health impacts due to exposure to PM2.5 and NO_2, only all-cause mortality in people +30 years old was considered. Mortality is the most studied health endpoint in association with air pollution. One reason is the widespread availability of mortality data for large populations, and another reason is its ease of interpretation.

Regarding the Relative Risk (RR) functions, due to the lack of epidemiological studies over the targeted geographic region, those provided by the tool (central value) and recommended by the WHO were used. The baseline mortality rate (960 per 100,000 individuals per year), was obtained from Portuguese health statistics. The general equation to estimate health impacts from air pollution is described as follows:

$$HI(p) = \sum_{i=1}^{n}[\,(P(p,i) \times I\,(i)) \times RR(p,i)\,] \quad (1)$$

where:

- HI(p) represents the number of unfavorable implications (cases of the disease, deaths) over all health indicators (i = 1, . . . , n) avoided, or not, due to pollutant exposure;
- P(p,i) is the population at risk associated with the RR;
- I(i) corresponds to the baseline incidence/prevalence rate of a specific health indicator i (expressed as the number of new cases per 100,000 individuals per year).

The economic valuation of health outcomes was performed by the value of statistical life (VSL) estimation. The VSL indicates how much individuals are willing to pay (WTP) to reduce the risk of death. This kind of evaluation is relevant from a decision-making point of view because it allows for a balance with the cost of air pollution improvement measures. For each avoided death, the VSL assumed was USD 2.798 M (EUR 2.370 M), as previously proposed by the Organization for Economic Co-operation and Development (OECD) [66]. Figure 10 shows the avoided premature deaths and related economic outcome estimated for both regions.

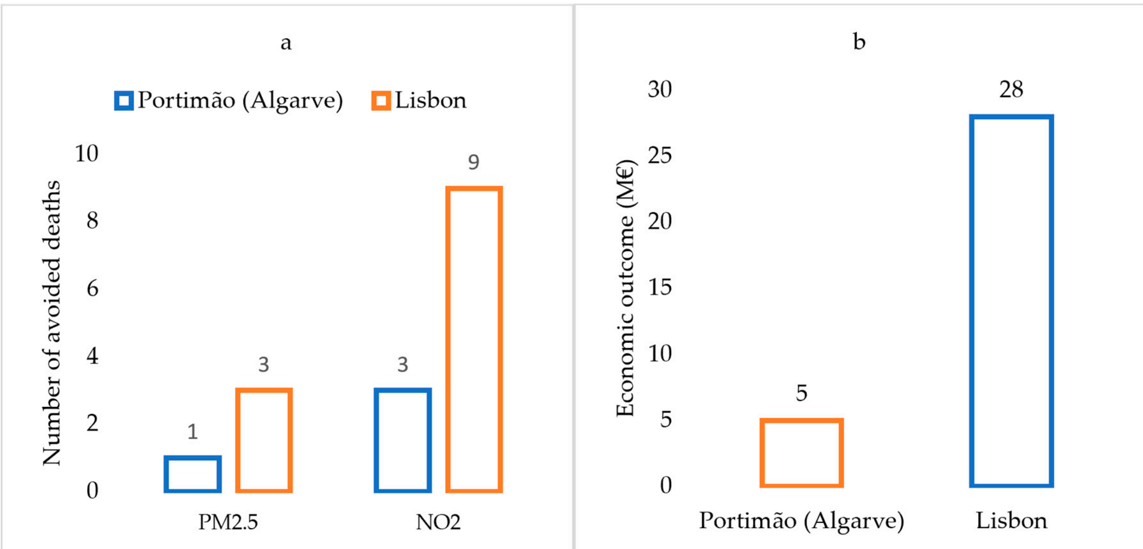

Figure 10. Avoided premature deaths (**a**) and related economic outcome in millions of Euros (**b**).

Results show that considering both pollutants, 14 premature fatalities were avoided due to reduced PM2.5 and NO_2 concentrations, when compared with the same period of 2015–2019. In Lisbon, the numbers are higher due to a higher pollutant reduction and population density.

However, these results should be analyzed taking into account the assumptions considered, in particular that the concentration levels measured at the air quality stations are representative of the population exposed in a particular area. Even if the population exposure is well estimated, individual exposures can vary substantially, as a result of spatial differences in air concentrations, and due to the individuals' activity patterns.

Additionally, only mortality was used as an indicator, but a wide range of morbidities has been associated with air pollution exposure. Another source of uncertainty is related to the choice of RR derived from epidemiology.

Finally, the WTP approach has the advantage of acquiring the full range of personal costs associated with the disease, but several health effects due to air pollution are often neglected and results are probably an underestimation of the total health costs.

5. Lessons Learned and Future Reflection

The COVID-19 pandemic was dramatic for the tourism industry, particularly by preventing people to travel abroad, which led to a significant decrease in international tourist arrivals and flights [7,9,13,19,67]. This decrease in demand was translated into a decline of tourism economic consumption [68], resulting in decreased tourism receipts [7,9,13], sometimes also associated with a decrease in prices [4,9]. For example, a historically low oil price (USD 23) was observed at the end of March 2020 [69], which also led to a considerable decrease in the price for air transportation [11]. Moreover, tourism is especially susceptible to measures to counteract pandemics because of restricted mobility and social distancing. This current crisis is generating spillover effects throughout supply chains. Therefore, countries highly dependent on foreign trade are more negatively affected [11]. Additionally, countries exposed to high international tourism flows are more prone to COVID-19 cases and deaths [8], which might constitute a barrier for future international travelers wishing for safe conditions during these uncertain times. Thus, small towns which highly rely on leisure tourism would be the most strongly impacted by COVID-19, thus causing the destruction of local tourism economies [70]. The global conjuncture of the pandemic resulted in additional social and economic losses, particularly the reduction in workers' salary [4,13] and increased unemployment rates [4,9,68]. Nevertheless, our carbon footprint was estimated to decrease, which is positive for the environmental and is in agreement with international goals (e.g., the Paris Agreement) [68]. Nonetheless, this achievement was obtained at the expense of several economic activities, such as tourism, meaning that the principles of sustainability were not reached.

The two examples addressed showed how the COVID pandemic has both negative and positive impacts, which helps us understand how crises can be an excellent opportunity for reset and significant changes. This section intends to promote a reflection on the lessons learned that can help build and shape the new future, focusing on tourism and environmental aspects.

Besides the actions of tourism companies and some incentives that have been made available to this industry such as subsidies, taxes reduction and better conditions regarding loan payments [7], several problems and challenges to recover and succeed in the tourism industry remain [3]. New concepts are needed for the tourism sector to survive, also because new and different pandemics will probably appear again [2]. Below is a list of new concepts that should guide tourism strategies in the future, ensuring a sustainable tourism development, rather than to return to business-as-usual when the crisis is over.

5.1. New Concepts of Tourism Connected to the Environment

There is an opportunity to reconsider a transformation of the tourism system to a system more aligned with the Sustainable Development Goals, to recognize and explore the potentialities of non-congested places, contact with nature, pure air and possibilities of some social distance. Additionally, this type of tourism already has some tradition in specific regions of the world, e.g., [71]; these alternative forms of tourism will be able to grow, with changes in tourism supply and travel behavior that can contribute to a greater environmental and also social wellbeing:

1. slow tourism, with longer stays at destinations with less and frequent traveling;
2. tourism focused on small-scale and local resources, and on environmentally conscious behaviors;
3. more individual tourism, looking for some isolation to experience nature and the environment;

4. in case of urban tourism, more sustainable options should be prioritized, with less impact on the environment (namely with sustainable mobility options, environmentally friendly accommodation and a higher ecological footprint).

5.2. Tourism 4.0

The COVID pandemic completely changed the way of working and teaching. Videoconferencing tools started to be used daily for home office workers and students. Considering this, virtual visits and guides, reaching a higher portion of the population and allowing people that could not travel to visit places and monuments should be stimulated. This new tourism concept also has extremely low environmental impacts associated with it. In the current context, where uncertainty prevails, the use of new technologies is argued to improve the competitiveness of both tourism companies and destinations involved in the digital transformation process, becoming more appealing to those visitors with major health and safety concerns [72]. Digital transformation is thus pushing tourism in new and often unpredictable directions. Digital technologies have important implications for tourism businesses of all sizes, for the structure and operation of the tourism value chains and for the sector as a whole [73] and its role within tourism is expected to step up [74]. In this context, technological approaches (e.g., augmented and virtual reality) arise as potential solutions, providing virtual and multisensory experiences of an attraction or a destination without the physical presence of the visitors [75]. Technologies are already starting to shape the way consumers behave, as well as how tourism experiences are designed [76]. However, if a person is willing to spend money or to engage in a non-traditional tourism experience driven by new technologies is still to be discovered, and deserves a careful debate, due to ethical and privacy issues, and because previous technological innovations (e.g., hospitality robots) failed in their purpose [74].

5.3. Growth of Domestic Market

Another potential transformation in the tourism supply and demand—which already happened as a response to the pandemic [5]—is to privilege the domestic market and focus on neighboring markets. These domestic trips, which usually involve shorter routes and are less likely to require flights, have a lower ecological footprint and could be more attractive for tourism demand for safety and economic reasons.

5.4. Mitigation of the Over-Tourism Problem

The need for rethinking the tourism sector can also be an opportunity to solve the problem of the over-tourism that exists in several regions, with strong negative impacts not only on environmental aspects but also on citizens' quality of life. According to other authors and previous studies [6,77], the focus should be on jobs rather than on GDP growth, increasing the investment in public jobs, home rental control, expanding public regulations and enforcement. Increased investment in environmentally friendly infrastructures with the support of government intervention, would be the most effective solution.

5.5. Using Air Quality as a New Attractiveness Criterion of Tourism Destinations

Air quality could be promoted as a valuable resource of a tourism destination and used as a criterion to increase competitiveness, stressing its potential benefits for tourism destinations, as well as the benefits for visitors (e.g., health improvements). Whether or not air pollution influences the decision to select a tourism destination and future intention behaviors (repetition of the visit or future recommendation), it may determine the future of tourism development. A damaged environment could be taken into account in tourists' decision-making processes and undermine tourism in the future. According to several studies, there are visitors from emerging countries, such as China, India and Russia that highly value nature and seek out clean air [78–80]. A recent study in Europe [81] also found that despite the fact that environmentally related travel mode decision priorities, like air quality impact and CO_2 emissions, are of secondary importance for travel mode decision making, they represent the most important antecedent of sustainable travel decision-making, highlighting that the behavior of tourists in relation to these environmental issues (namely air quality) will probably temporarily be in the second row of priorities, keeping in mind the acuteness of the present crisis for travelers and potential travelers around the globe. Some indexes of destinations' competitiveness, such as the Travel and Tourism Competitiveness Index, already incorporate criteria such as particulate matter concentrations, along with many other, to determine the competitiveness of countries as tourism destinations [82], while others have omitted it but recognize its relevance [83]. This suggests that criteria related to air quality may play an important role in influencing the competitiveness of tourism destinations, and countries like Portugal could be a good example on how to use this attractiveness criteria in choosing holiday destinations. This new vision of identifying natural resources, such as air quality as a precious heritage, will promote tourism sustainability, shaping a new identity and awareness for destinations. This would also influence the future of urban planning and environmental options over these touristic areas, namely regarding mobility systems, seeking an urban environment with safe and clean air.

All these options and strategies show that tourism and the environmental policies can and should work together in prefiguring alternative trajectories for the future, benefiting the individual's well-being [84], preparing the world for a more responsible travel and tourism experience while considering a sustainable growth path with increased environmental awareness. A joint weighting of these possibilities will bring a win–win strategy for the tourism–environment relationship.

6. Conclusions

This paper is one of the first attempts to demonstrate that COVID-19 had (and still has) both negative and positive impacts. Tourism activity was severely damaged due to the significant decrease in tourist arrivals and consequent decline of tourism revenues, which led to a temporary or permanent shutdown of several associated activities (e.g., accommodation establishments, restaurants, airlines, local shops). As shown, regions such as Lisbon and Algarve, which represented more than 60% of the total revenue in accommodation establishments in Portugal during 2019, registered losses of 65% and 52.5%, respectively, during the first three quarters of 2020. Thus, regions more dependent on tourism activity are now struggling to revitalize their economy and to develop alternative economic growth models less reliant on tourism or oriented to a truly sustainable approach, able to encompass the three main dimensions (social, economic, and environmental) associated to sustainability. In contrast, as a consequence of several governmental measures to prevent the rapid spread of the number of infections (e.g., lockdowns, movement re-strictions) and a change in population mobility trends, pollutant concentrations significantly decreased, particularly during the period that corresponded to more restrictive measures. These reductions were observed for PM10, PM2.5 and NO_2, although with some variations. Furthermore, this paper also proved that human health has benefited from the observed air quality improvements, as supported by the analysis of avoided premature deaths. Nevertheless, it should be noticed that this health benefits analysis was independent of other health impacts, and does not include the excess of deaths resulting from COVID-19 disease.

Still, a more in-depth analysis is required to understand the true implications of COVID-19 on the tourism industry. For instance, this paper only addressed the impacts on overnight stays and revenue of accommodation establishments, disregarding the effects on tourism jobs, specifically due to the absence of data. Besides the estimates of the World Tourism Organization (UNWTO) [21] and Kitamura et al. (2020) [68], little is known concerning the impacts of the pandemic on employment in the tourism sector. Future works should focus on this issue and provide some insight concerning how tourism firms will adapt their labor force to potential pandemic crises in the future. It would be interesting to develop further studies about crisis management in the tourism industry. The air quality analysis in this paper mainly focused on urban monitoring stations in two tourism destinations (Lisbon and Algarve), representative of the cultural and business tourism in urban areas, as well as of sun and sea tourism, respectively. Additionally, a comparison of potential differences between urban and rural monitoring stations in destinations associated with nature tourism would be of added value. Such an approach might be complemented with a more accurate analysis of the tourists' preferences for rural destinations during the pandemic period, which might contribute to differentiated market approaches in the short-run, with a clear emphasis on the air conditions of such destinations. Future studies are also invited to analyze the impacts of the pandemic in future travel choices of potential visitors with a particular emphasis on the environmentally sustainable dimension (e.g., sustainable tourism destinations, carbon-free transportation, pro-environmental behaviors).

Besides all these limitations and future work, the analysis performed, and the lessons learned from the pandemic and lockdown, allowed for the identification of recommendations and guidelines for future tourism development. This list includes new concepts of tourism connected to the environment; the investment in online/virtual tourism activities; promotion of the domestic market; mitigation of over-tourism and using environmental issues, such as air quality, as new attractiveness criteria for tourism destinations.

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