# Higher than reported

## Assessing mortality rates during the COVID-19 pandemic in Turkey

**OCTOBER 2020**

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**YOU CAN ACCESS THE WHOLE RAW DATA USED FOR THIS STUDY AT https://covid19.nar-research.com/**

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Latest update **October 25th 2020**

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# Who are we?

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The scope of our analysis is the Eastern Mediterranean region and surrounding areas, especially countries like Turkey, Greece, Iran and Cyprus. We prepare thematic, sectorial or on demand reports, do personal or virtual advisory work for those who want to know more about the region, and organize informative events. Our clients receive regular summaries of the most important events, a panoramic of the topics that will trend tomorrow, and bibliographical recommendations.

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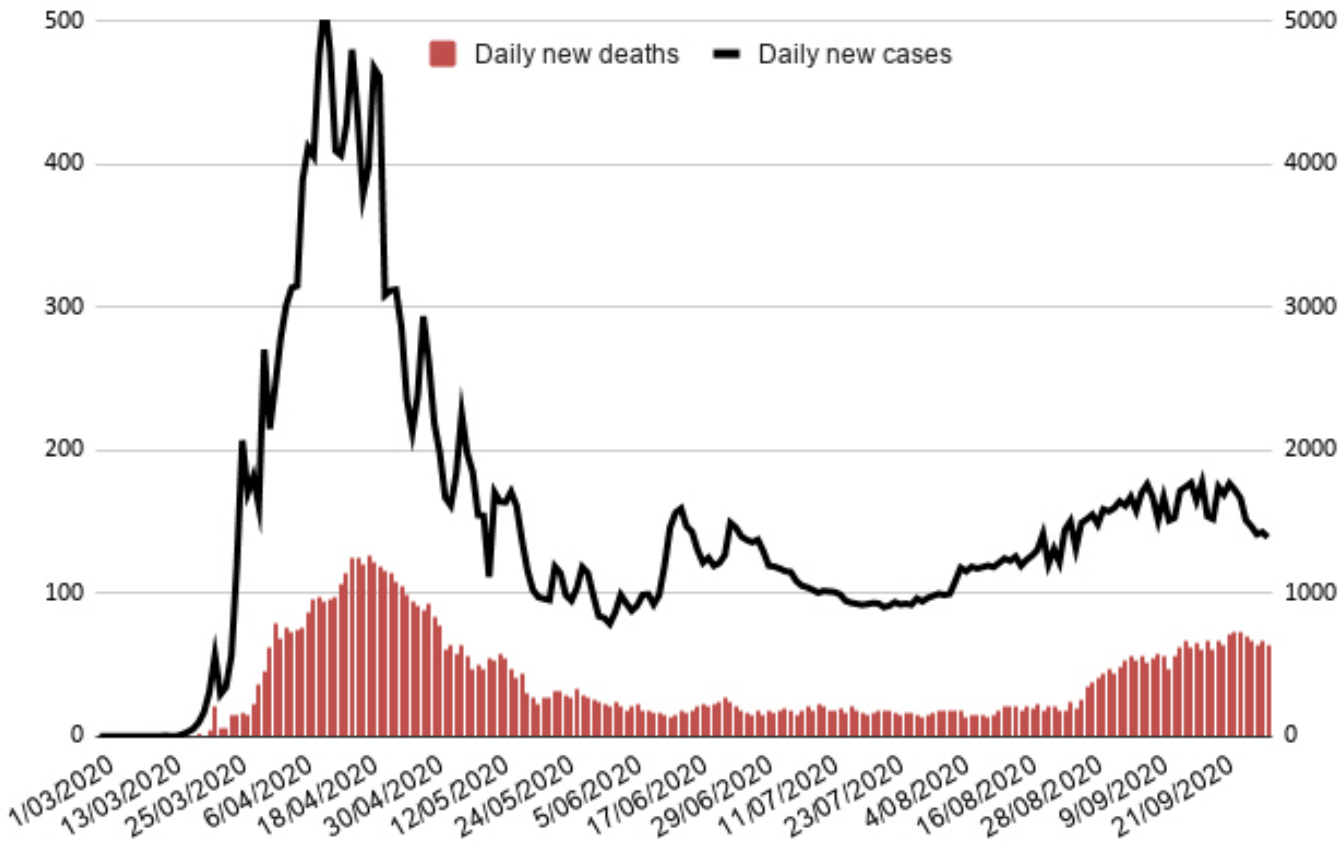
# Highlights

In the 12 provinces studied -Istanbul included- **we found an excess mortality toll up to 10,642 deaths**: 5,148 during the first wave (March-June) and 5,494 deaths during the current second wave (July-September). This points to a clear underreporting of COVID-19 related deaths since, for the same period, the official death toll was 8,195 (5,131 and 3,064) for the whole of Turkey.

According to the official data on the geographical distribution of COVID-19 in Turkey, as well as our own calculations, the 12 examined provinces account for around two thirds of COVID-19 related deaths (75%-80% for the first wave, around 60% during the second). Thus, taking into account the excess of mortality, **we estimate that the real toll of COVID-19 in Turkey could be twice the official data, around 12,500-16,000** (still not a very high mortality rate in comparison with other European countries).

## COVID-19 in Turkey (official data)



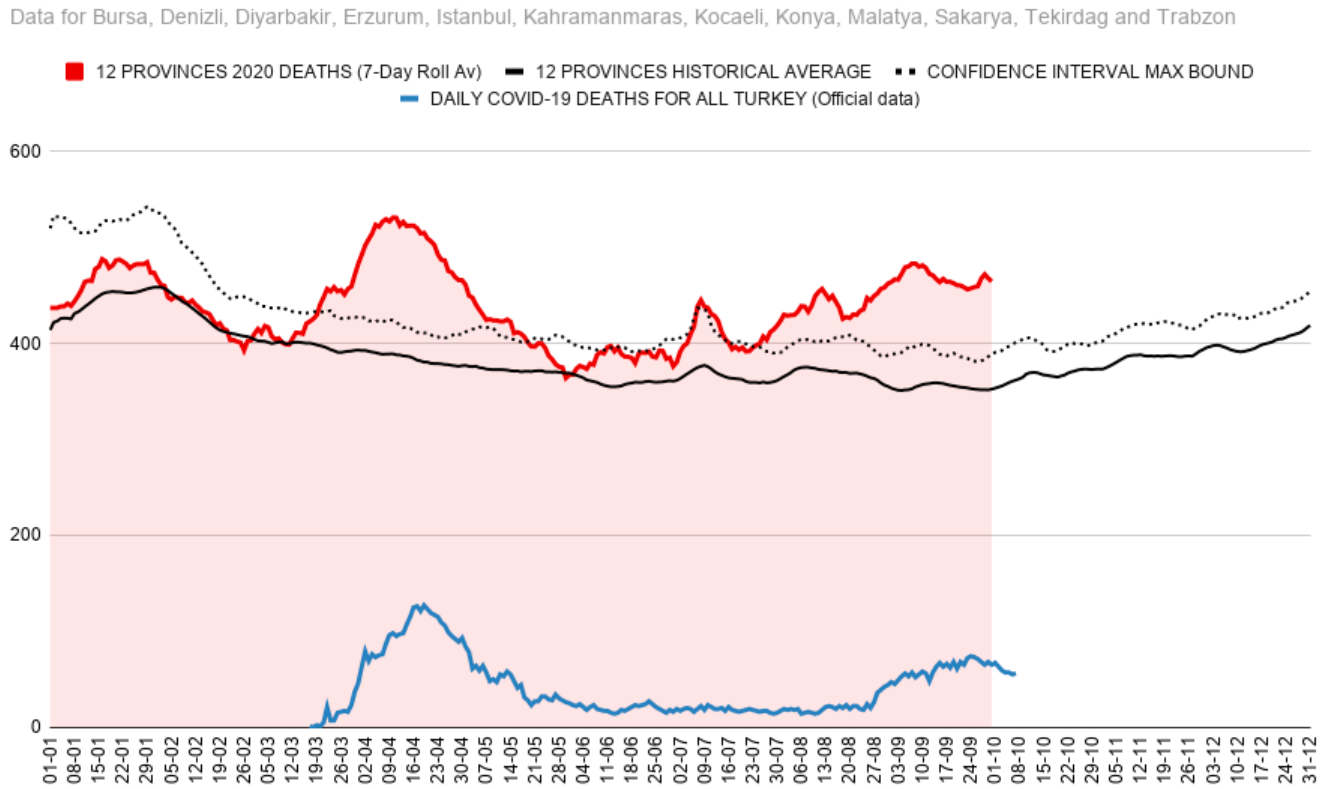

**Source:** Turkish Ministry of Health.

The first COVID-19 wave was concentrated in Istanbul and the surrounding provinces as well as in Izmir, but after June, when preventive measures were relaxed and the ban to travel between certain provinces was lifted, people moved to their family villages and towns or second residences (especially during the Kurban Bayrami or Eid al-Adha, at the end of July). As a consequence, the disease spread throughout the country. Specially concerning has been the situation in the Eastern

and Southeastern Anatolian regions -the less developed part of the country-, where there are fewer available hospital beds and social conditions make difficult to keep social distance inside crowded homes, which has led to higher mortality rates in those provinces.

On the 29th of July, Health Ministry changed overnight the way it communicated COVID-19 statistics: using the wording “new patients” instead of “new cases”, and “seriously ill” instead of “in Intensive Care Units” or “intubated patients”.

## Excess mortality in 12 Turkish provinces



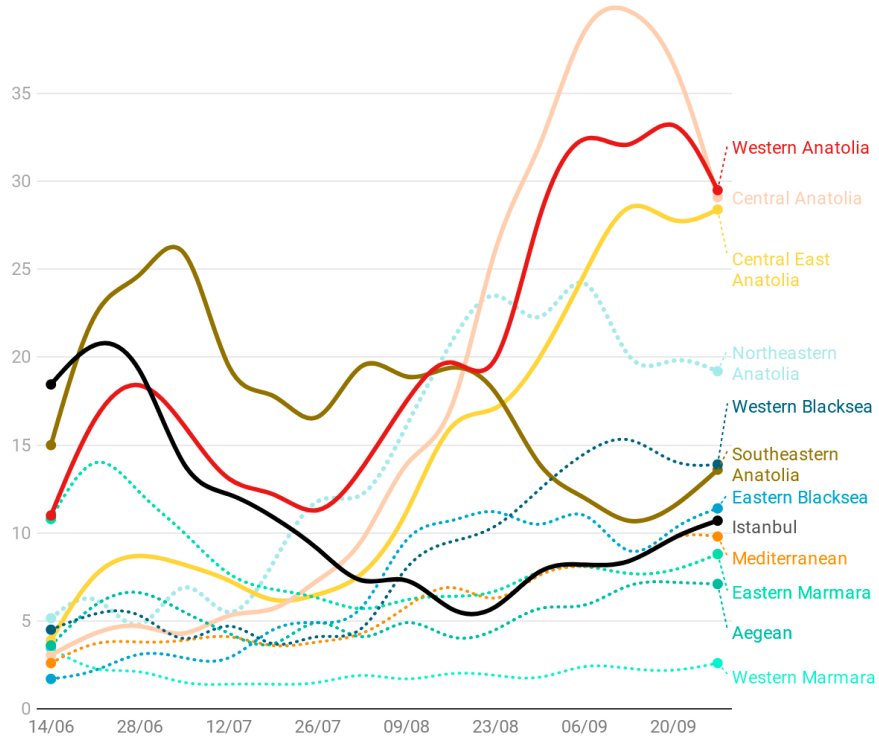

**Source:** Municipal Death Registers / Own calculation

In September, the minister himself acknowledged that its department was not counting asymptomatic patients who tested positive in PCR tests as new cases, which led to the questioning of official figures. Trust in the official numbers and measures taken by the Turkish Government was quite high at the beginning of the pandemic but has plummeted due to this lack of transparency. At NÂR Research, we estimate that 80% of the deaths were duly reported during the first wave of the COVID-19 epidemic in Turkey (March-June) but, on the contrary, **during the second and current wave (July-September) we think that 2 in every 3 deaths may have gone unreported.** We consider, in line with the World Health Organization recommendations, that the population is in need of more transparency in order to comply with the preventive measures and the individuals, companies and organizations to make well informed decisions.

# Findings

Given the the lack of transparency of some Governments and/or their lack of capacity to provide accurate statistics, the reporting based on excess mortality has become one of the main tools for investigators to assess the real death toll of the COVID-19 pandemic, as the works of EUROMOMO, Instituto de Salud Carlos III (ISCIII) and the Financial Times have shown.

## COVID-19 Cumulative Incidence per region (Cases per 100,000 population in the last 7 days)



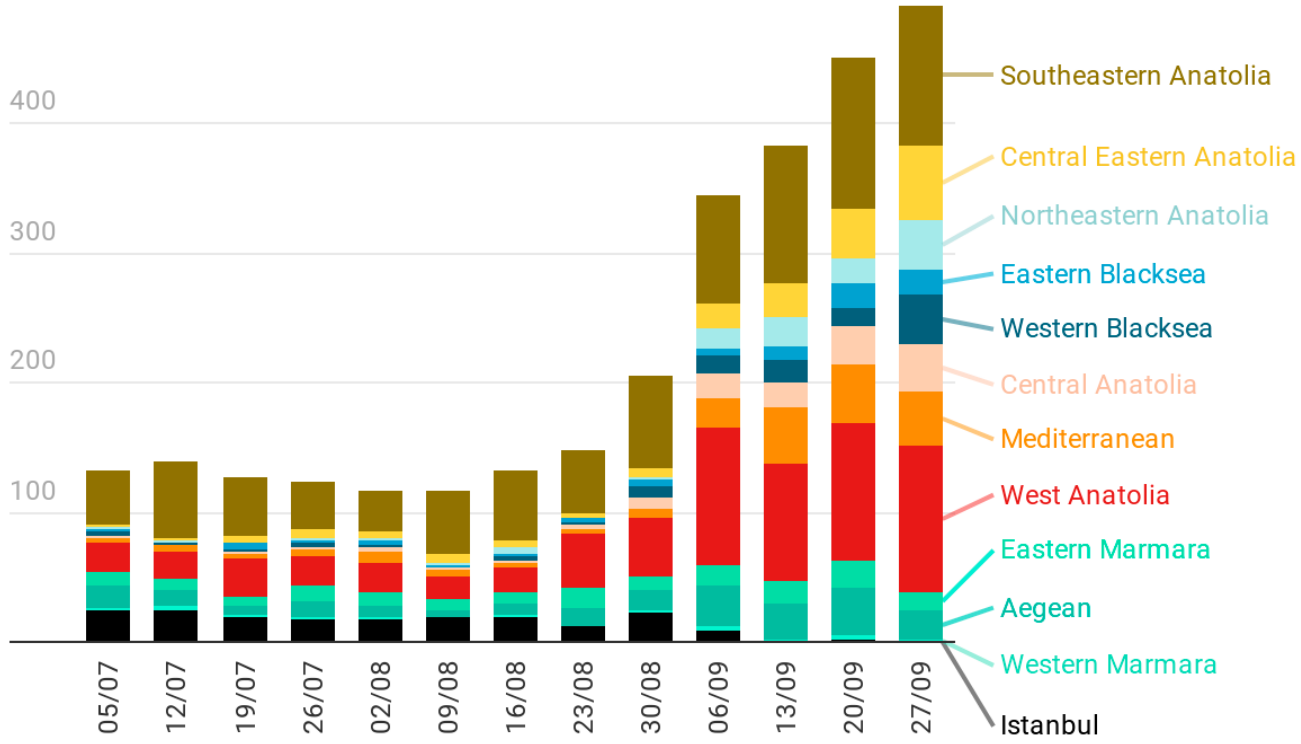

## Turkey Statistical Regions (NUTS-1)


**Sources:** Turkish Ministry of Health.

This presents a problem, since not all the excess mortality can be attributed to COVID-19. “Some of it, we know, is due to people that postpone visits to the hospitals fearing to be infected of COVID-19 and thus aggravating pre-existent conditions or illnesses”, explained a Turkish doctor and representative of the Turkish Medical Association. In any case, we can conclude that excess mortality, specially at moments when it gets over 10-20% or more the historical average rate, indicates that those deaths are clearly related to the COVID-19 pandemic, be it directly or indirectly.

According to the analysis of the General Directorate of Meteorology, in July and September temperatures were hotter than in previous years, especially regarding average and minimum temperatures. We cannot exclude that this led to more deaths than expected, but we do not consider this as the main reason for the high excess mortality registered in Turkey. Temperatures during winter and spring months were also milder than in 2019.

## Weekly COVID-19 deaths by NUTS-1 region (official data)




**Source:** Turkish Ministry of Health.

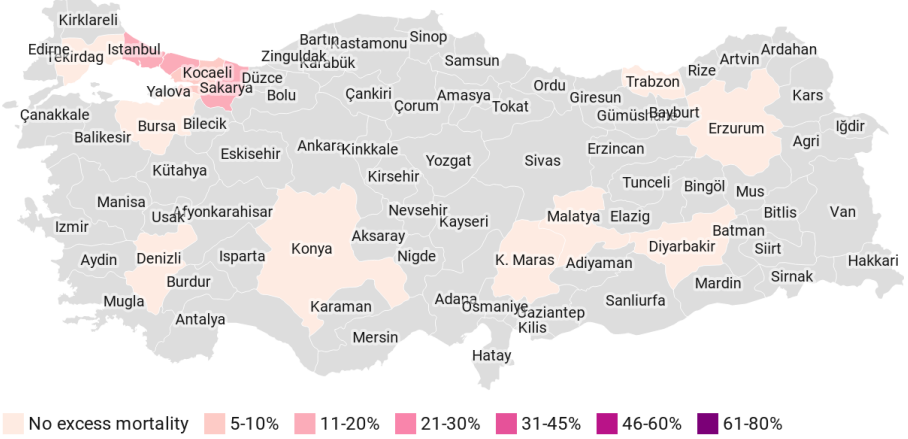
In Turkey, just 11 out of the 81 provinces offer an open access to their Municipal Register of Deaths, with name and age of the deceased, trough the e-Devlet system (a platform offering electronic access to a wide range of Government and Local services). The province of Trabzon, on the other hand, keeps an open register on its own Metropolitan Municipality webpage.

As some scholars and journalists started to use this data in March-April to double-check the official figures of COVID-19 deaths, the Government decided to remove the cause of death that accompanied the daily list of deceased. It also established a captcha to prevent automatized data scraping. Thus, we have had to collect the data manually, which can lead to some minor errors as the data is constantly updated with new numbers. In most Turkish provinces, new deaths are registered using the date when the decease took place, not the day of notification. In practice, this means that the data of September cannot be counted as definitive as new deaths could be added during October. The only exception is Trabzon, where every death is registered as on the day of notification.

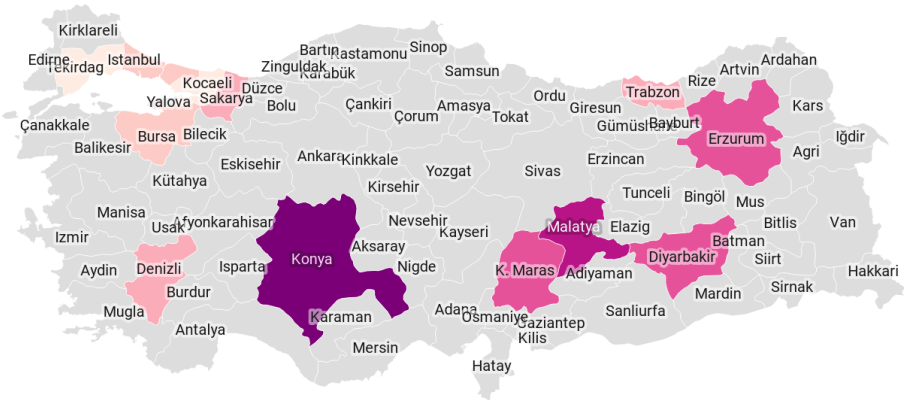
In some cases, the quality of these datasets is mixed (see more in the “Methodology & notes” section). As a consequence, we also had to rely on studies on mortality done by the Turkish Statistical Institute (TURKSTAT) to weight the data.

These 12 provinces (Bursa, Denizli, Diyarbakır, Erzurum, Istanbul, Kahramanmaraş, Kocaeli, Konya, Malatya, Sakarya, Tekirdağ and Trabzon) amounted to one third of the total annual deaths in Turkey during the last ten years (Min. 32.59%, Max. 33.18%) according to TURKSTAT data. Moreover, based on official data on the geographical distribution of COVID-19 in Turkey, as well as our own calculations, we estimate that these 12 provinces account for around two thirds of COVID-19-related deaths: 75%-80% for the first wave of the pandemic (mid-March to the end of June), and around 60% during the current second wave (July-September).[1]

## First wave: May - June 2020




## Second wave: July - September 2020




**Source:** Municipal Death Registers / Own calculation

By early April, Turkey had detected COVID-19 infections in all provinces of the country, although over 60% of the cases were concentrated in its most populous city-province: Istanbul. The 2nd and 3rd biggest cities in the country, the capital Ankara and the coastal city of Izmir, had around 5% of the cases each. The bulk of the rest of cases were in the provinces around the Marmara Sea (Kocaeli, Sakarya, Bursa...), which is the most industrialized part of the country and closely linked to Istanbul.

In order not to ruin an economy already in dire straits, the Government opted for a policy of lockdowns only during the weekends and holidays, allowing people who could not work remotely to go to their workplaces during weekdays. Apart from that,

1 After the European Union asked for more transparency in the Turkish COVID-19 data in order to study whether to include the country in their safe travel list, the Ministry of Health of Turkey started publishing daily and weekly reports on the geographical distribution of cases and deaths. This data covers the period from the end of June to the present. For the previous months, we relied on medical reports and journalistic accounts. See https://sbsgm.saglik.gov.tr/TR,66560/haftalik-rapor--weekly-report.html.

the Government imposed a ban on traveling between certain provinces (Istanbul, Ankara and Izmir included). Despite some criticism, the measures were effective: the pressure on hospitals was not extreme, the tracing teams were working and the Government managed to take down the number of daily new cases and deaths to reasonable levels. Despite the high number of cumulative cases (around 165,000 at the beginning of June) the death toll (4,563 according to official data, around 6,000 according to our estimate) was lower than in other European countries, such as Germany, Belgium and the Netherlands.

However, pressure to reopen the country for tourism in the summer season was high, given the fact that neighboring and competing countries such as Greece, Cyprus and Georgia were less affected by the pandemic (See our previous June report on Tourism and COVID-19), something that led to a hasty relaxing of preemptive measures and to the lifting of the travel ban between provinces, despite the advice of medical associations.

During the summer, people moved to their family villages and towns or second residences (especially during the Kurban Bayrami or Eid al-Adha, at the end of July) and, as a consequence, the disease spread throughout the country. This can be seen clearly in our charts at provincial levels: those provinces that registered an excess mortality during the first wave had a less lethal second wave, while those provinces that were almost unaffected in terms of excess mortality during the first wave, incurred in more deaths during the summer months.

Particularly concerning has been the situation in the Eastern and Southeastern Anatolian regions -the poorest part of the country-, where there are fewer available hospital beds and social conditions make difficult to keep social distance inside crowded homes, which has led to higher mortality rates in those provinces. Ankara was also badly hit by the second wave. However, since they do not have an open register of deaths, we are not able to evaluate their data in the light of excess mortality.

**For the March-September period in the 12 provinces examined we found 10,642 deceased more than expected, based on the historical average of deaths for these places.** The minimum excess mortality we calculate for these provinces is 8,530 but we think that 10,642 is closer to reality (For more information on our calculations see Methodology). This figure is bigger than the 8,195 COVID-19 deaths acknowledged by the Ministry of Health for the whole of Turkey in the same period.

For the first wave (March-June), we found 5,148 extra deaths. The worst cases were those of Istanbul, Sakarya and Kocaeli, which in April recorded a 30-40% excess of mortality. **Just in April, Istanbul had 2,750 deceased more than expected.**

The second wave (July-September) hit inner Anatolia worse. We found 5,494 deaths over the expected number. **Provinces such as Malatya, Diyarbakır, Erzurum and Kahramanmaraş registered between 35% and 51% more deceased than in previous years.** Konya had an even higher excess mortality (76%), although we have some reservations about the data of this province (See “Methodology & notes”).

| Month | MARCH | | | APRIL | | | MAY | | | JUNE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Expected mortality | 2020 Deaths | **Excess Mortality** | Expected mortality | 2020 Deaths | **Excess Mortality** | Expected mortality | 2020 Deaths | **Excess Mortality** | Expected mortality | 2020 Deaths | **Excess Mortality** |
| Bursa | 1,487 | 1,523 | **36** | 1,405 | 1,424 | **19** | 1,404 | 1,377 | - | 1,268 | 1,338 | **70** |
| Denizli | 607 | 598 | - | 573 | 598 | **25** | 557 | 566 | **9** | 520 | 563 | **43** |
| Diyarbakir | 471 | 477 | **6** | 457 | 368 | - | 434 | 344 | - | 446 | 405 | - |
| Erzurum | 370 | 380 | **10** | 381 | 339 | - | 417 | 353 | - | 404 | 395 | - |
| Istanbul | 6,772 | 7,289 | **517** | 6,269 | 9,019 | **2,750** | 6,236 | 6,831 | **595** | 5,776 | 6,046 | **270** |
| Kahramanmaras | 481 | 506 | **25** | 442 | 474 | **32** | 461 | 480 | **19** | 431 | 440 | **9** |
| Kocaeli | 785 | 800 | **15** | 692 | 905 | **213** | 695 | 707 | **12** | 657 | 683 | **26** |
| Konya | 547 | 479 | - | 470 | 468 | - | 470 | 497 | **27** | 455 | 429 | - |
| Malatya | 334 | 329 | - | 323 | 295 | - | 412 | 247 | - | 393 | 220 | - |
| Sakarya | 503 | 622 | **119** | 487 | 683 | **196** | 503 | 537 | **34** | 501 | 544 | **43** |
| Tekirdag | 122 | 136 | **14** | 128 | 141 | **13** | 139 | 135 | - | 116 | 112 | - |
| Trabzon | 442 | 425 | - | 428 | 380 | - | 442 | 353 | - | 428 | 399 | - |
| TOTAL | - | - | **742** | - | - | **3,248** | - | - | **696** | - | - | **461** |
| Official COVID death toll for the whole country | | | **214** | | | **2,960** | | | **1,366** | | | **591** |

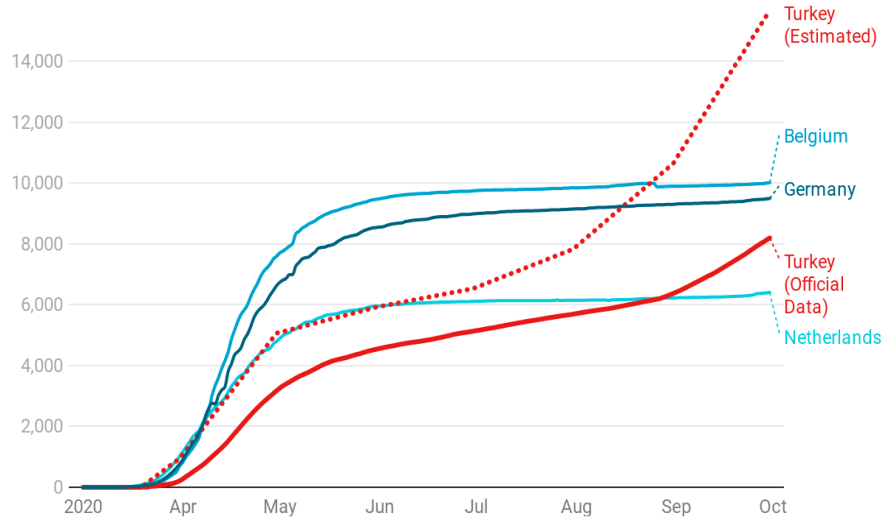
| Month | JULY | | | AUGUST | | | SEPTEMBER | | |
|---|---|---|---|---|---|---|---|---|---|
| | Expected mortality | 2020 Deaths | **Excess Mortality** | Expected mortality | 2020 Deaths | **Excess Mortality** | Expected mortality | 2020 Deaths | **Excess Mortality** |
| Bursa | 1,353 | 1,517 | **164** | 1,373 | 1,399 | **26** | 1,271 | 1,453 | **182** |
| Denizli | 589 | 634 | **45** | 551 | 638 | **87** | 522 | 638 | **116** |
| Diyarbakir | 488 | 603 | **114** | 499 | 707 | **208** | 434 | 622 | **188** |
| Erzurum | 419 | 452 | **33** | 459 | 664 | **205** | 385 | 659 | **274** |
| Istanbul | 6,039 | 6,105 | **66** | 5,977 | 6,332 | **355** | 5,594 | 6,249 | **655** |
| Kahramanmaras | 499 | 569 | **70** | 465 | 657 | **192** | 450 | 730 | **280** |
| Kocaeli | 701 | 703 | **2** | 687 | 676 | - | 658 | 681 | **23** |
| Konya | 511 | 711 | **200** | 496 | 962 | **466** | 478 | 948 | **470** |
| Malatya | 354 | 344 | - | 366 | 500 | **134** | 313 | 721 | **408** |
| Sakarya | 488 | 636 | **148** | 519 | 577 | **58** | 518 | 597 | **79** |
| Tekirdag | 138 | 134 | - | 137 | 145 | **8** | 141 | 116 | - |
| Trabzon | 442 | 471 | **29** | 442 | 491 | **49** | 428 | 587 | **160** |
| TOTAL | - | - | **872** | - | - | **1,788** | - | - | **2,835** |
| Official COVID death toll for the whole country | | | **560** | | | **679** | | | **1,825** |

According to the official data on the geographical distribution of COVID-19 in Turkey as well as our own calculations, the 12 examined provinces account for around two thirds of COVID-19-related deaths (75%-80% for the first wave, around 60% during the second). **Thus, we estimate that the real death toll of COVID-19 in Turkey could be a minimum of 12,500 and up to twice the official data, around 16,000 (still not a very high mortality rate in comparison with other European countries but notably higher than officially reported).**

Trust in in the official numbers and measures taken by the Turkish Government was quite high at the beginning of the pandemic but plummeted due to lack of transparency. On the 29th of July, Health Ministry changed overnight the way it communicated COVID-19 statistics: using the wording “new patients” instead of “new cases”, and “seriously ill” instead of “in Intensive Care Units” or “Intubated patients”. In September, the minister of Health, Fahrettin Koca, acknowledged that its department was not counting asymptomatic patients who tested positive in PCR tests as new cases, which led to questioning the official figures. Furthermore, in an interview with Turkish daily Habertürk in early October, Koca said that the tests positivity

rate was 10%, which would make the number of daily new cases close to 11,000 (as the number of daily test is around 110,000) instead of the 1,500-1,700 reported by the Ministry of Health. In fact, several doctors have challenged the official data, saying that in August and September the daily number of new cases in Ankara alone was over one thousand.

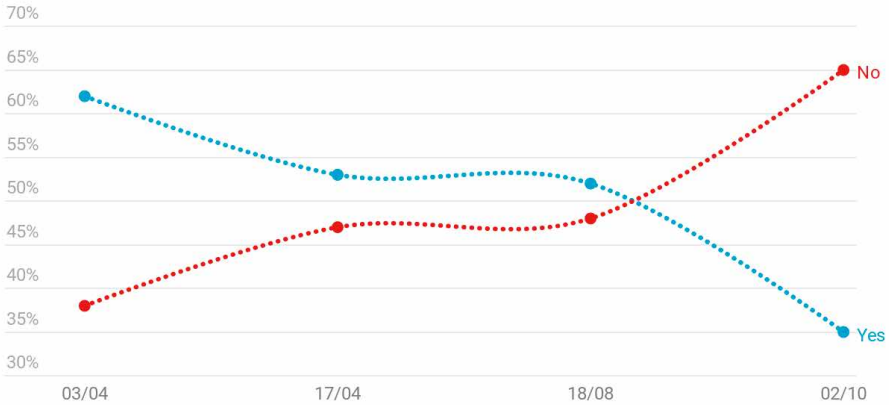
## COVID-19 deaths in selected countries




**Source:** Our World in Data / Own calculations.

Regarding mortality, at NÂR Research we estimate that 80% of the deaths were duly reported during the first wave of the epidemic in Turkey but, in contrast, during the current second wave, we consider that 2 in every 3 deaths may have gone unreported. For instance, on 29th August, the mayor of Ankara Mansur Yavas said that the total COVID-19-related deaths in the province until then was 563, while the official number of deaths for the corresponding NUTS-1 region, West Anatolia, was 576, even if this region includes other provinces, such as Karaman and Konya, which also reported a very high mortality rate.[2] The mayor also noted that in one August day, 17 peopled died due to COVID-19 in Ankara but the official number for the whole country was only 20, at a time while other provinces, as Diyarbakır, Urfa and Gaziantep were heavily struggling with the epidemic.

## Do you trust the COVID-19 statistics published by the Turkish Health Ministry?

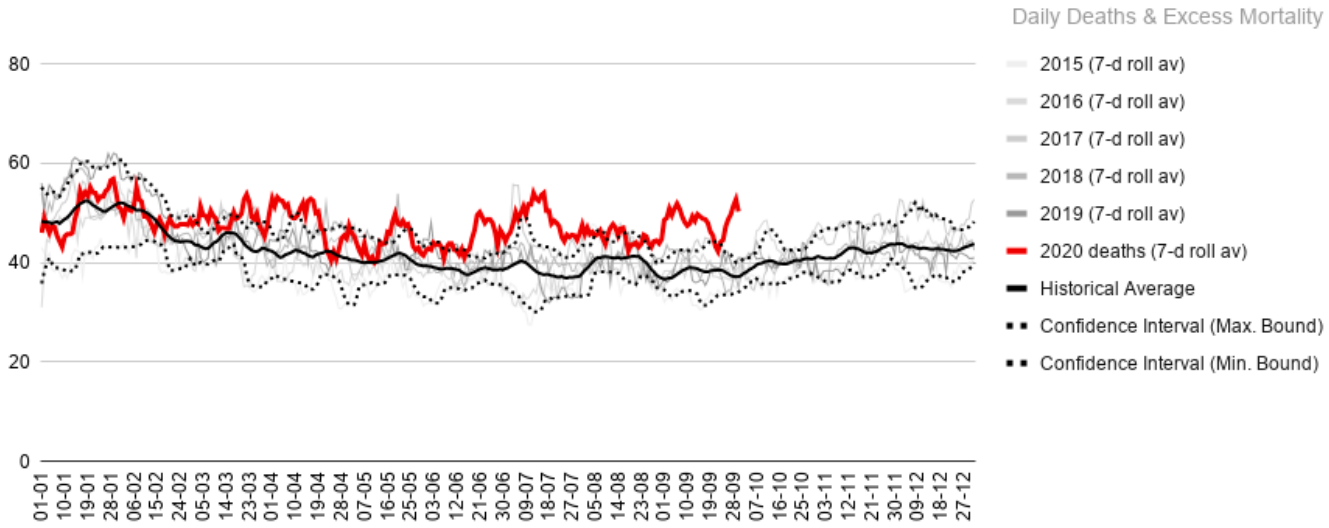



**Source:** Istanbul Ekonomi Araştırma

2 The Ministry of Health does not provide disaggregated data by province but by NUTS-1 statistical region (a broader unit that includes several provinces).

# Assesment by province

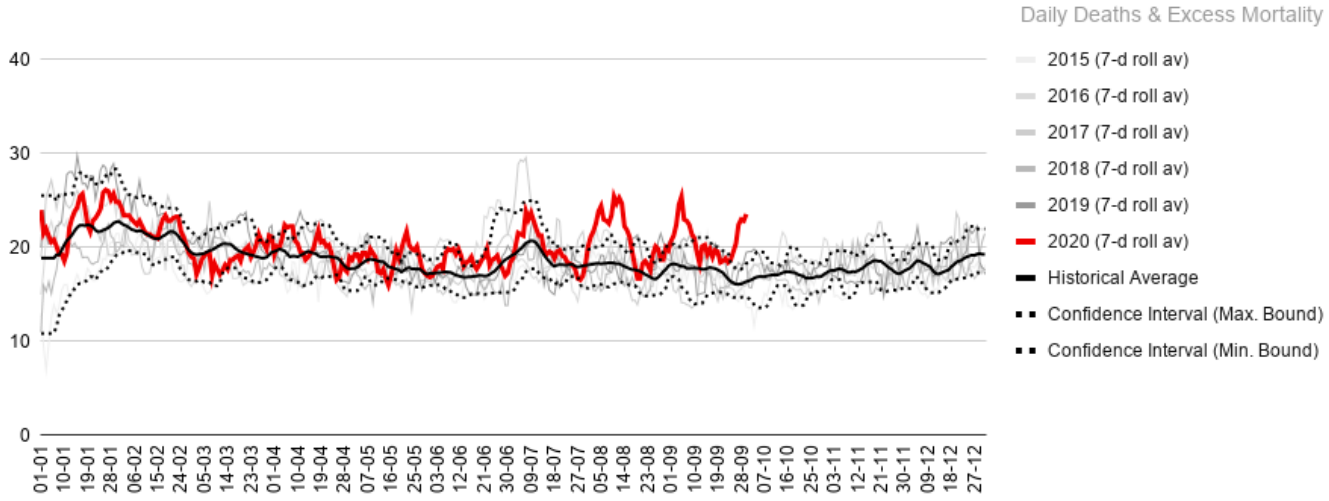
## Bursa




Bursa is an industrial province on the Southern coast of the Marmara Sea with a population of 3.06 million. According to news reports, it had a medium-high number of confirmed cases of COVID-19 since the beginning of the pandemic in Turkey. The mortality rates remained within the boundaries of confidence levels (close to the maximum bound) and did not start to pose a real excess mortality until July-September. Nevertheless, the excess mortality rates were not as high as in other provinces (12-14%).

However, we still think that the number of deaths is higher than official records show: the Ministry of Health stated that there were 158 deaths from 29th June to 27th September in the NUTS-1 statistical region of East Marmara (TR4), which also includes other provinces (Kocaeli, Sakarya, Eskisehir, Bilecik, Düzce, Bolu and Yalova), but we estimate that between July and September there were 371 extra deaths in Bursa alone.

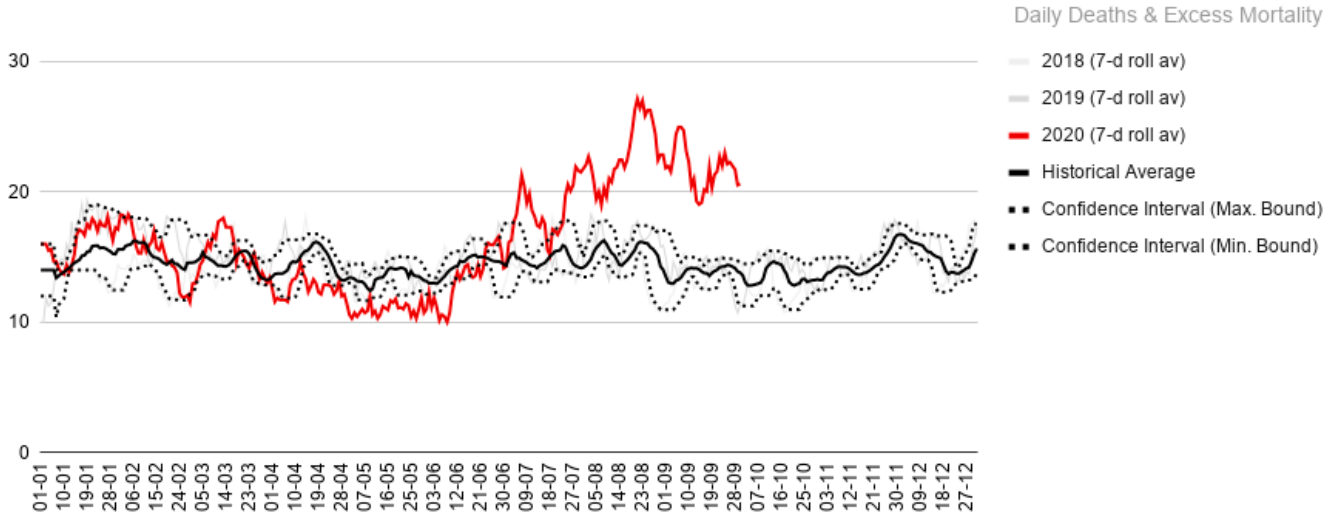
## Denizli




Denizli is a province in the inner Aegean region with a population of 1.04 million. It was not very much affected by the COVID-19 pandemic with just some dozens of cases in the first months. Mortality also remained within the boundaries of confidence levels up until the summer months. It registered two peaks at the beginning of August and in September, when it posed an excess mortality of more than 20% of the expected levels.

For the period of July-September we estimate that there were 249 extra deaths in Denizli. The Ministry of Health only registered 219 COVID-19-related deaths for the whole NUTS-1 statistical region of the Aegean (TR3), which besides Denizli includes the provinces of Aydin, Mugla, Manisa, Afyonkarahisar, Kütahya, Usak and Izmir, the third biggest city in Turkey.

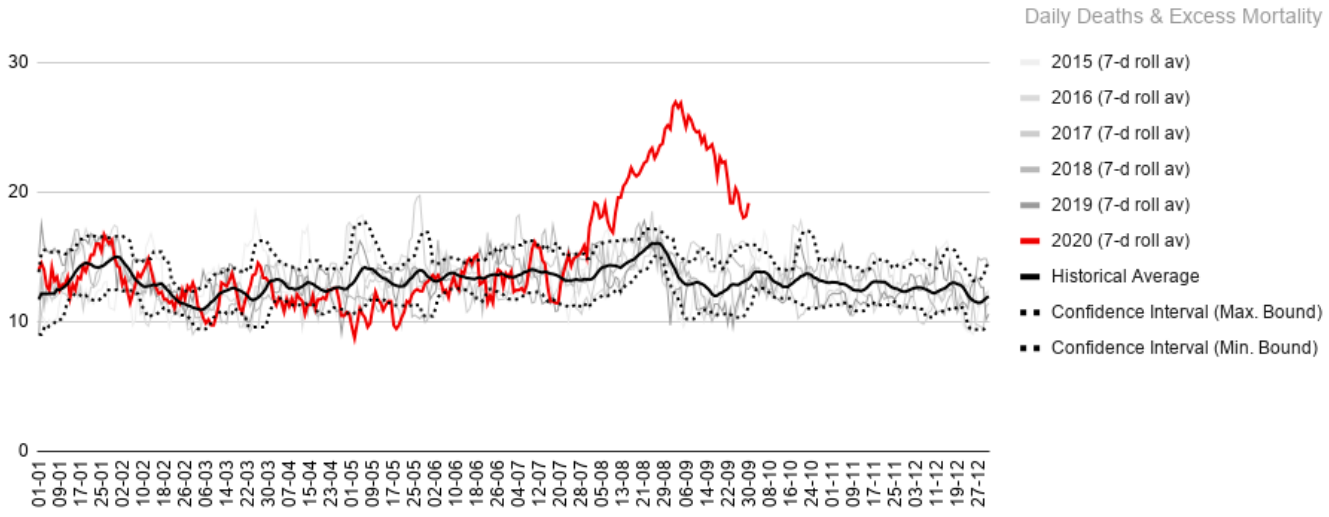
## Diyarbakır




Diyarbakır is one of the most populous provinces in Southeastern Anatolia, the poorest region of Turkey in terms of GDP per capita. It has a 1.76 million population, mainly Kurdish (the biggest ethnic minority in the country). Diyarbakır was spared of the first wave of the COVID-19, but the number of cases and deaths skyrocketed during the summer, once the ban to travel from other provinces was lifted. Doctors complained of the lack of enough hospital beds to look after the patients.

Between March and June the mortality rates were lower than the historical average. However, during summer the number of deaths was very high: over 20% of the expected number in July, over 40% in July and over 50% in September. Thus, we consider the death toll of 853 given by the Ministry of Health for the NUTS-1 statistical region of Southeastern Anatolia (TRC) for the 29th of June to 27th of September period to be below the real number of deaths. We estimate the excess mortality in Diyarbakır alone to be of 542 for the same period. In the same region there are provinces more populated than Diyarbakır, such as Gaziantep and Şanlıurfa (over 2 million each) that also had very serious COVID-19 outbreaks during summer.

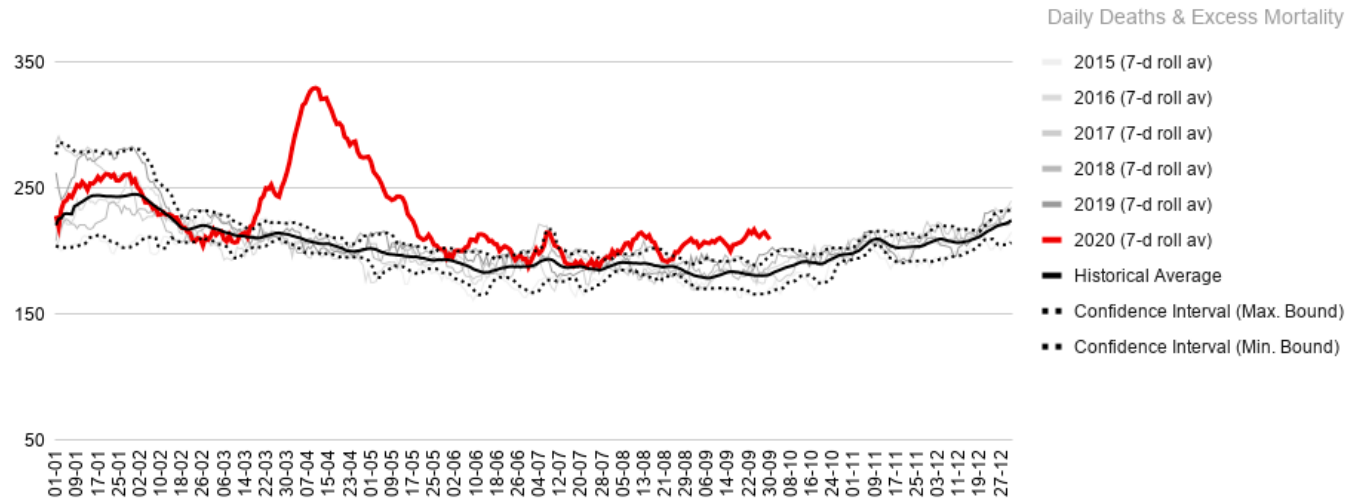
## Erzurum




With a population of 760,000, Erzurum is a province of Eastern Anatolia with very long and extremely cold winters and short summers. As in other provinces of the Eastern half of Turkey, there was not a real first wave of infections in Erzurum, and the number of COVID-19 cases remained low. During spring, the mortality levels remained under the historical average. It was only during summer that the number of deaths started to increase. By August it reached worrying levels, getting worse in September, with a peak of excess mortality of 70% over the expected level.

For the NUTS-1 statistical region of Northeast Anatolia (TRA), which includes Erzurum and other six provinces, the Ministry of Health registered just 109 COVID-19 deaths for the summer months, but in Erzurum alone we found up to 514 extra deaths.

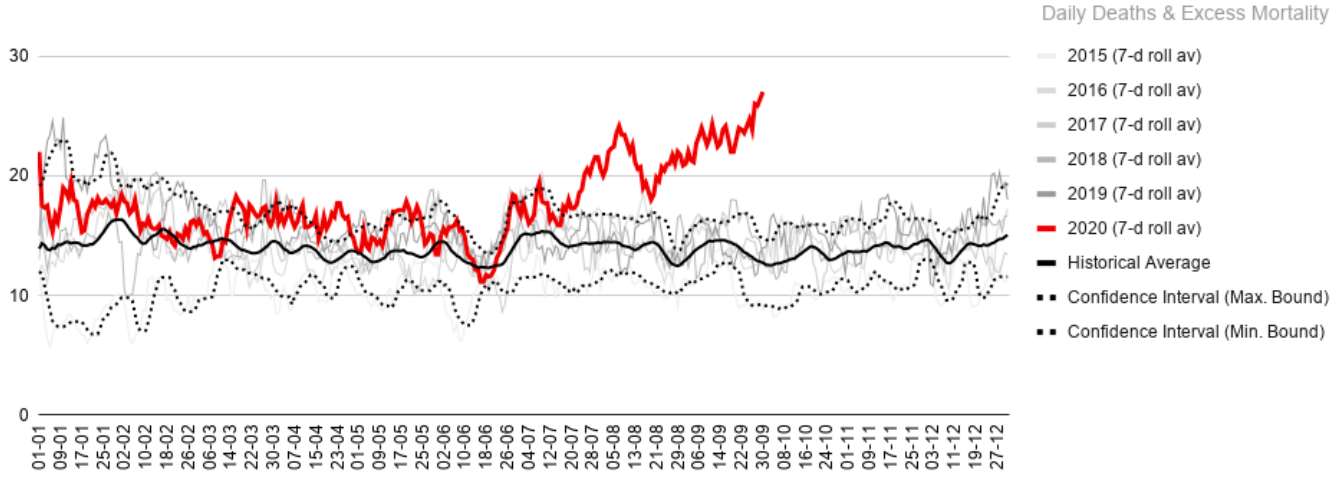
## Istanbul




Istanbul is the economic capital and biggest city in Turkey with an official population of 15.52 million, although some estimation put the real number of inhabitants over 17 million (as there are students, workers and migrants registered in other provinces that live most of the year in Istanbul). It was the center of the epidemic during the first wave, concentrating around 60% of the COVID-19 cases and over 50% of the official number of deaths. However, month by month, this percentage has been reduced as the epidemic spread to other parts of the country. Also, in absolute terms, the number of contagions and incidence per 100,000 population has been lower during the second wave.

Istanbul registered a very high excess mortality in April (around 45% or 2,700 people over the expected number). It registered some smaller peaks later, in June and August, and an excess mortality over 10% in September (around 650 extra deaths). We found the Ministry of Health data for Istanbul regarding deaths highly unreliable, as only 187 people were registered as deceased because of COVID-19 during the second wave (and only 9 in September), while we found an excess mortality of 1,077 for the same period.

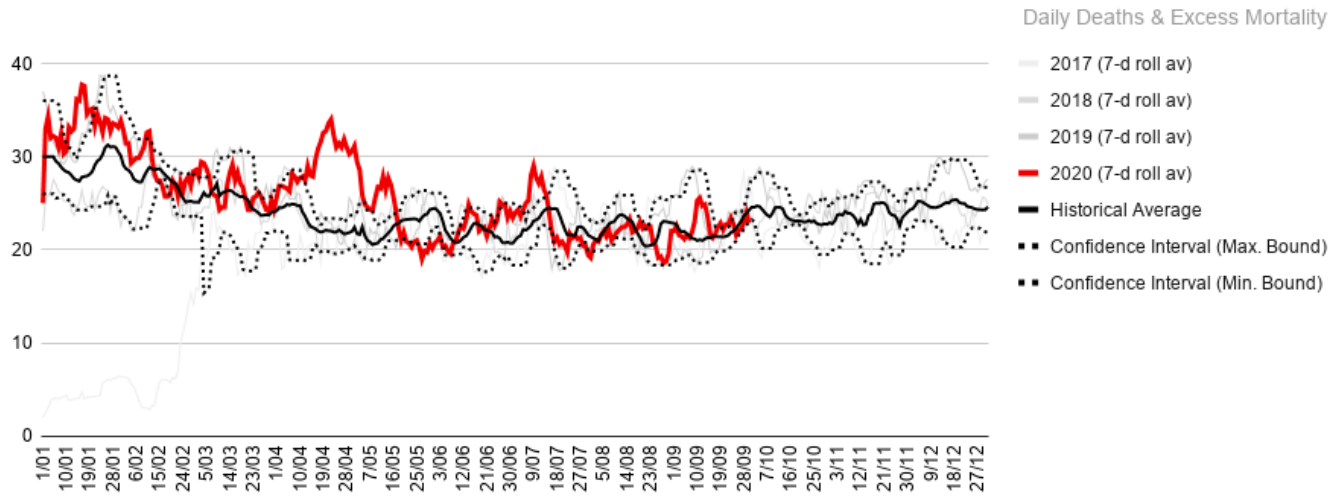
## Kahramanmaraş




Kahramanmaraş is a province with a population of 1.15 million situated at the junction of the Central Anatolia, Southeastern Anatolia and Mediterranean regions. As in other provinces of the Eastern half of Turkey, there was not a real first wave of infections in Kahramanmaraş, with a very low number of COVID-19 cases. There was no real excess mortality, although the level during the spring months remained very close to the higher bound of the confidence interval. After the second half of July, the province started to record worrying levels of mortality, which went up to over 60% in September.

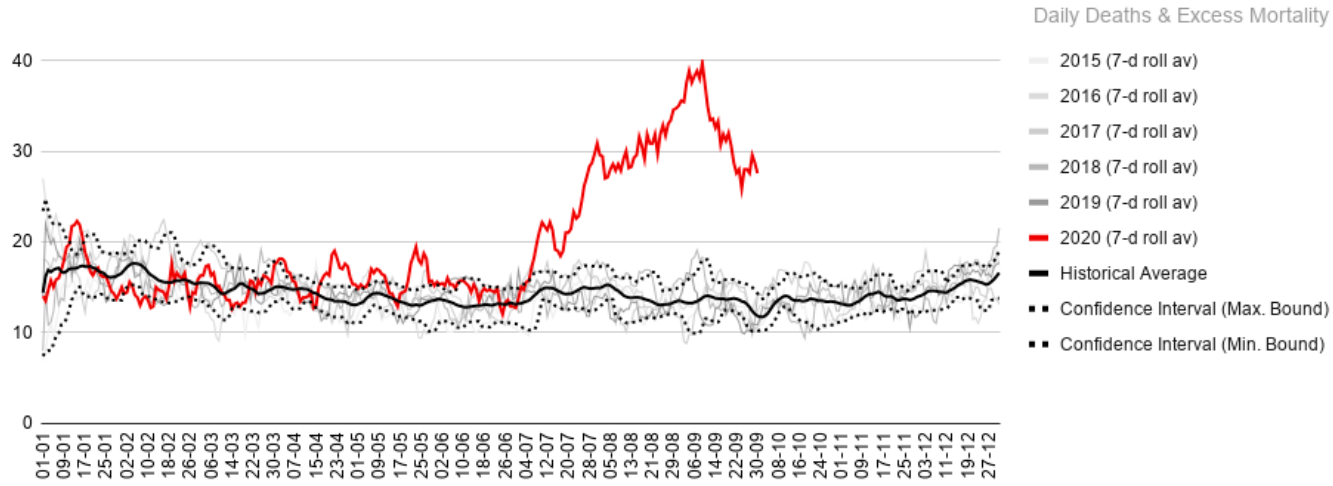
The numbers published by the Ministry of Health for the second wave (July to September) are also unreliable in this case as they only acknowledge 198 COVID-19 deaths for the NUTS-1 Statistical Region of the Mediterranean (TR6), which is made by 9 provinces, including big cities such as Antalya, Mersin and Adana. We have found an excess mortality of 543 in the same period for Kahramanmaraş alone.

## Kocaeli




Kocaeli is an industrial province in the Eastern shore of the Marmara Sea with a population of 1.95 million. As it is neighboring Istanbul, the COVID-19 pandemic quickly spread to this province, which recorded a high excess mortality in April (over 30%). However, once this peak passed, the mortality levels remained within the normal parameters.

## Konya

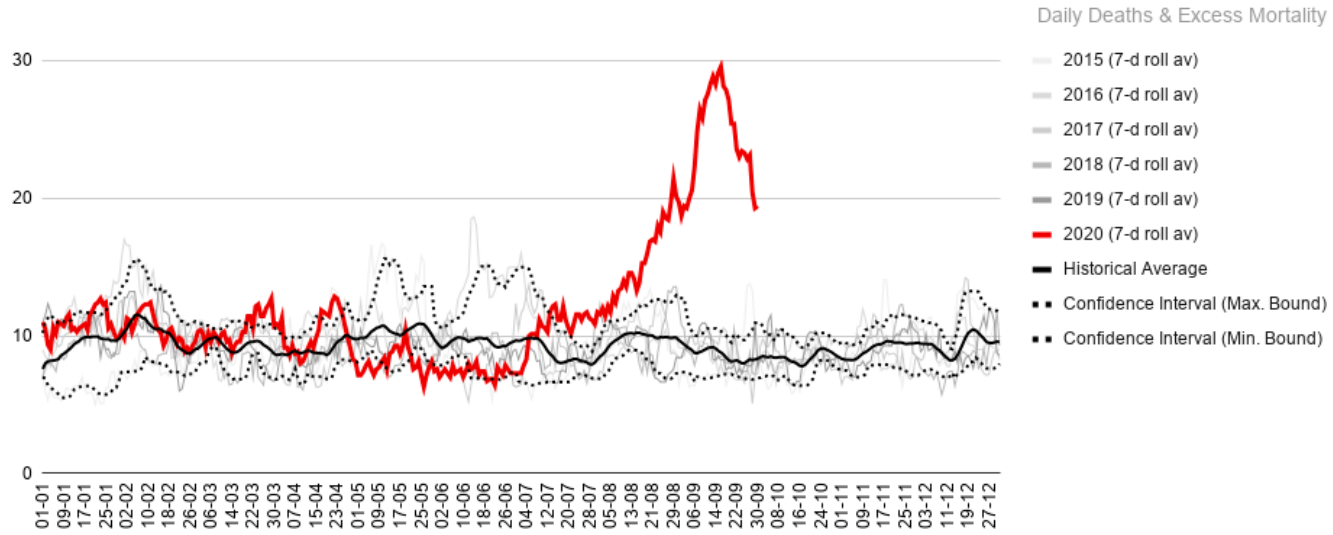



Konya is a province in inner Anatolia with a population of 2.23 million. One of the earliest COVID-19 outbreaks in Turkey took place in this region, when some people returning from the pilgrimage to Mecca (Saudi Arabia) tested positive. However, except for small peaks in April and May, there was not a big excess mortality until the beginning of July, when numbers skyrocketed and the number of deceased in August and September were twice the expected rate.

We have to point out, however, that the dataset of Konya is not completely reliable as, contrary to the case of other provinces, the total number of deaths of previous years provided by the Death Register of the Municipality are far below those of the Statistical Institute TURKSTAT.

According to the Ministry of Health, there were 656 COVID-19-related deaths from 29th June to 27th September in the NUTS-1 statistical region of West Anatolia, which includes Konya, Karaman and Ankara, one of the worst hit provinces during the second wave.

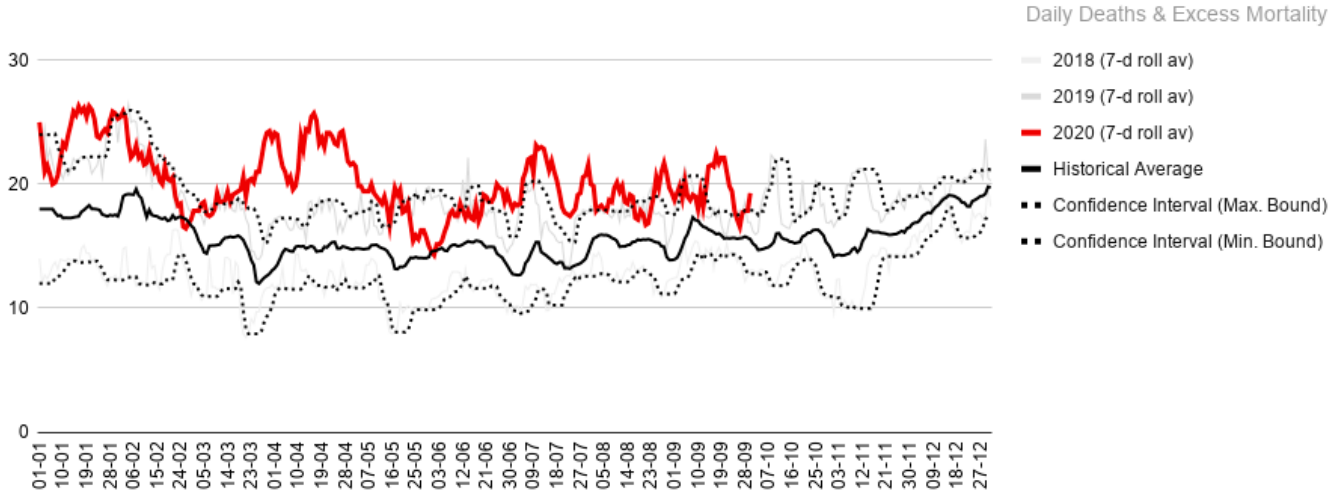
## Malatya




Malatya is an agrarian province in Eastern Anatolia with a population of 800,000. As in other provinces of the Eastern half of Turkey, there was not a real first wave of infections in Malatya, and the number of COVID-19 cases remained low. During spring, the mortality levels remained under the historical average. It was only in August that the number of deaths started to increase. The data from September is very worrying, because the number of deaths is 130% over the expected level.

For the NUTS-1 statistical region of Central East Anatolia (TRB), which includes Erzurum and other seven provinces, the Ministry of Health registered just 185 COVID-19 deaths for the summer months, but in Malatya alone we found up to 542 extra deaths.

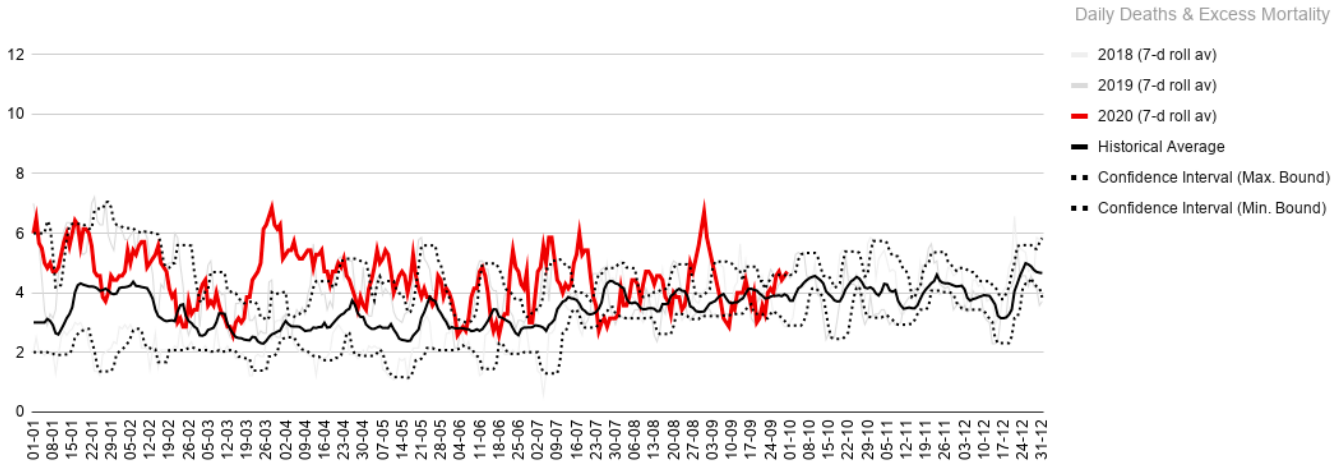
## Sakarya




Sakarya is a province with a population of 1.03 million situated in the Black Sea coast. As it is closely connected to Istanbul by the highway that links that city with the capital, Ankara, the COVID-19 pandemic quickly spread to this province, which recorded a high excess mortality in March and April (over 20 and 40%). Then, mortality levels went down, but always remained close to, or slightly over, the maximum bound of the confidence interval. Thus, mortality rates showed a constant, but not very high, excess mortality.

The Ministry of Health stated that there were 158 deaths from 29th June to 27th September in the NUTS-1 statistical region of East Marmara (TR4), which also includes other provinces (Kocaeli, Bursa, Eskisehir, Bilecik, Düzce, Bolu and Yalova). We estimate that between July and September there were 285 extra deaths in Sakarya alone.

# Tekirdağ

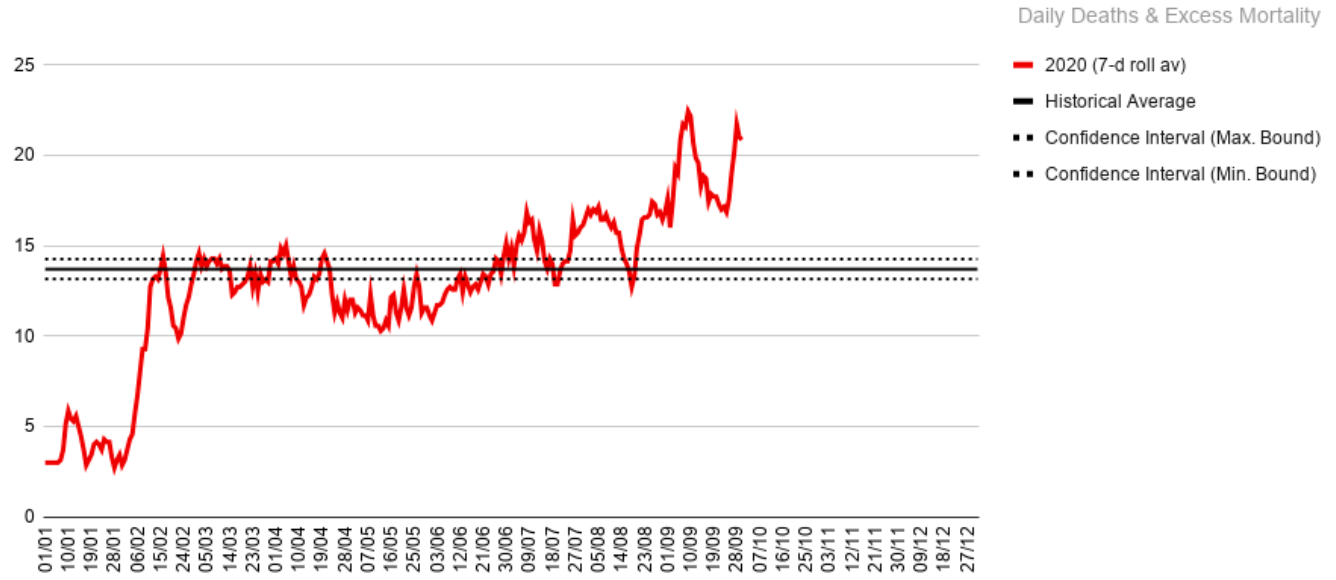



Tekirdağ is a province in Thrace with a population of 1.05 million. As it is neighboring Istanbul, the cases in Tekirdağ rapidly increased during the first month of the COVID-19 pandemic, although later stabilized thanks to the ban to travel from and to Istanbul. Tekirdağ recorded some excess mortality in March and April, but later the numbers returned to normal parameters (except for a peak in August).

We have to point out, however, that the dataset of Tekirdağ is not completely reliable since, contrary to the case of other provinces, the total number of deaths of previous years provided by the Death Register of the Municipality are far below those of the Statistical Institute TURKSTAT.

The Ministry of Health stated that there were 23 deaths from 29th June to 27th September in the NUTS-1 statistical region of West Marmara (TR2), which also includes other four provinces. In this case, it is more or less consistent with our findings.

# Trabzon




Trabzon is a province in the coast of the Black Sea with a population of 809,000. As in other provinces of the Eastern half of Turkey, there was not a real first wave of infections in Trabzon, which had a low number of COVID-19 cases. During spring, the mortality levels remained well under the historical average. It was only at mid-summer that the number of deaths started to increase. In September Trabzon recorded a 37% excess mortality over the expected level.

We found unreliable the Trabzon Municipality's Death Register data for previous years (also the data for January to mid-February 2020). For that reason, we compared the data with the average daily deaths extracted from TURKSTAT. Eventually, however, we decided to use the municipal data for 2020 deaths, because after March they are consistent with the average deaths in TURKSTAT studies.

The Ministry of Health stated that there were 76 COVID-19-related deaths from 29th June to 27th September in the NUTS-1 statistical region of Eastern Black Sea (TR9), which besides Trabzon includes other five less populated provinces. For Trabzon alone we estimate that the excess mortality could be around 230.

# Methodology & notes

**FIRST AND SECOND WAVE:** At NÂR Research we are not epidemiological experts. We used the wording First & Second Wave on purely methodological basis to differentiate two periods: first from March to June, when the COVID-19 pandemic broke in Turkey and lockdowns were imposed, and the second, from July to September, when preventive measures and lockdowns were completely lifted. According to official data, new daily cases went down 1,000 per day in May, then increased and went down again. From mid-July onwards they started to rise again.

**RAW DATA:** As stated above, we collected the data from the Municipalities Register of Deaths (Municipalities that have a mandate on the whole province territory). We did it manually, which may have led to some errors, since the data are constantly updated with new numbers: except in Trabzon, where every death is included in the day of notification, the rest of the provinces include the death in the day it happened, even if it was weeks before. For this reason, the data of September cannot be counted as definitive, as new deaths could be added during October and thus the death toll could go up as far as 5-10%. Some provinces such as Konya, Bursa and Diyarbakır upload the up-to-date data with a considerable delay.

We found that some queries in the databases of Erzurum and Diyarbakır constantly return an error for certain days. As statistically speaking this does not change very much the whole dataset, we opted for substituting the data of these days with an average of the previous 7 days.

We also opted to exclude the data of the 29th of February in order not to have inconsistencies for leap-years.

We double-checked the validity of the Municipal data with that of the Turkish Statistical Institute (TURKSTAT), which publishes studies on mortality for previous years but not disaggregated by day or week and province (just by province and year, or by the whole country and month). We concluded that the data from both sources are consistent for most of the provinces. We have some doubts about the data on Tekirdağ and Konya, since their municipally registered deaths are far below those registered by TURKSTAT. This could be due to methodological reasons (perhaps Municipalities register the deaths that happen in their province and TURKSTAT register them according to the province of official residence), but we cannot be completely sure of this.

**DATA SOURCES:**

Bursa: https://www.turkiye.gov.tr/bursa-buyuksehir-belediyesi-vefat-sorgulama
Denizli: https://www.turkiye.gov.tr/denizli-buyuksehir-belediyesi-vefat-sorgulama
Diyarbakır: https://www.turkiye.gov.tr/Diyarbakır-buyuksehir-belediyesi-vefat-sorgulama
Erzurum: https://www.turkiye.gov.tr/erzurum-buyuksehir-belediyesi-vefat-sorgulama
Istanbul: https://www.turkiye.gov.tr/istanbul-buyuksehir-belediyesi-vefat-sorgulama
Kahramanmaraş: https://www.turkiye.gov.tr/Kahramanma-

raş-buyuksehir-belediyesi-vefat-sorgulama
Kocaeli: https://www.turkiye.gov.tr/kocaeli-buyuksehir-belediyesi-vefat-sorgulama
Konya: https://www.turkiye.gov.tr/konya-buyuksehir-belediyesi-vefat-sorgulama
Malatya: https://www.turkiye.gov.tr/malatya-buyuksehir-belediyesi-vefat-sorgulama
Sakarya: https://www.turkiye.gov.tr/sakarya-buyuksehir-belediyesi-vefat-sorgulama
Tekirdağ: https://www.turkiye.gov.tr/Tekirdağ-buyuksehir-belediyesi-vefat-sorgulama
Trabzon: https://www.trabzon.bel.tr/vefat-edenler.aspx
TURKSTAT: https://www.tuik.gov.tr/en/

**YOU CAN ACCESS THE WHOLE RAW DATA USED FOR THIS STUDY AT** https://covid19.nar-research.com/

**ROLLING AVERAGE (ROLL. AV.):** As other studies, we have used a 7-day rolling average to eliminate important deviations on the higher and lower ends (which could have been caused by a punctual event as a major road accident or a terrorist attack). We use this rolling average for the provincial charts and for the calculation of the confidence intervals. For calculating the excess mortality, we use the raw data of 2020.

**HISTORICAL AVERAGE:** For our calculations we have used the 7-day rolling average of the 5 previous years (2015-2019) for all the provinces except for the following ones: for Kocaeli we only have used the 2017-2019 data; for Diyarbakır, Sakarya and Tekirdağ we used the 2018-2019 data, because the number of deaths from previous years presented inconsistencies or we found it unreliable; Finally, for Trabzon, we used the TURKSTAT data to calculate the historical average, because we only find reliable its data from mid-February 2020.

**CONFIDENCE INTERVALS:** To show the normal parameters of mortality we calculated a confidence interval. The MAXIMUM BOUND is calculated as the 90th percentile of all the numbers in the seven previous days of the five previous years (7-day rolling average). The MINIMUM BOUND is calculated as the 10th percentile of all the numbers in the seven previous days of the five previous years (7-day rolling average).

**EXPECTED DEATHS & EXCESS MORTALITY CALCULATION:** For the calculation of the excess mortality for each province, we compared the raw data of 2020 with the expected number of deaths. This expected number of deaths is a line between the historical average and the maximum bound of the confidence interval, decided in each province by weighting the Municipal data with the TURKSTAT data. For instance, in Bursa we calculated the excess mortality on the basis of the Maximum bound of the confidence interval as the TURKSTAT data is closer to that number than to the historical average. For Denizli, however, we opted for calculating the excess mortality with the historical average as the TURKSTAT data is closer to that parameter. In other cases, we used a weighted average between both rates.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