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COVID 19 IN ROMANIA: ASSESSING PREVALENCE, MORTALITY AND FATALITY BY AGE AND GENDER IN THE FIRST 32 WEEKS OF THE PANDEMIC

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***Abstract**: Gender and age play an important role in shaping the risk of developing severe infection with COVID-19. The exposure to risks associated with COVID-19 differs by country, but the factors explaining the cross-national variations are not fully understood, while the analyses of incidence, mortality and fatality by gender and age cover a handful of countries, Romanian not included. This paper focuses on the unfolding of the COVID pandemic in Romania, looking at prevalence, mortality rate and case fatality rate by age and gender, over the first 32 weeks of the pandemic. Data retrieved from EUROSTAT and the weekly reports issued by the National Institute of Public Health (NIPH) reveals the uneven distribution of prevalence and fatality across gender and age groups. The results show that the infection was more spread among women between 40 and 59 years old, while men paid a higher death toll unevenly distributed across age groups.*

***Keywords:** COVID-19 Pandemic; Prevalence; Mortality; Case Fatality Rate; Gender Disparities*

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Introduction

Gender seems to play an important role in shaping the risk of developing severe symptoms in case of COVID-19 with men being exposed to higher risks as compared to women (Ahrenfeldt et al., 2020). According to previous studies, the age-gender conjunction makes older men more vulnerable to the risks of death (Shah et al., 2020), but there is significant cross-country variation of the gender mortality ratio by age groups (Ng et al., 2020).

Knowing how the risk of getting infected and passing away varies across gender and age groups is crucial for designing effective policies against the pandemic, especially when it is about generalizing the experience of other countries (Demombynes, 2020). So far, the studies documented uneven exposure to risks associated with COVID 19 in different countries, but the factors explaining cross-national variations are not fully understood, while the analyses of incidence, mortality and fatality by gender and age group cover a limited number of countries, Romania not included. This paper focuses on the unfolding of the COVID pandemic in Romania, looking at the dynamic of prevalence, mortality rate and case fatality rate by age groups and gender over the first 32 weeks of the pandemic (30 March – 22 November 2020). Using data retrieved from EUROSTAT and the weekly reports issued by the National Institute of Public Health (NIPH), we present the distribution of risk of infection and death across gender and age groups.

The article consists of five parts. The first section presents the general pattern of risk exposure related to COVID 19 and the factors that may shape the unfolding of the pandemic in Romania from the demographic point of view. The second part introduces the data and the methods employed by the analysis, while the fourth discusses the results. The final section concludes on the results and provides recommendations for further research.

Theoretical framework

Prevalence, mortality, and Case Fatality Rate (CFR) are often employed to describe the impact of epidemics on populations and to document public policies addressing the health emergency. While prevalence points to the spreading of the virus, showing the share of those who got infected of the total population, mortality and CFR talk about the severity of the infection. The first one refers to the occurrence of deaths caused by the virus within a population, in a given period of time, and the second indicates the number of deaths in reference to the confirmed cases of infected individuals (WHO, 2020).

Although the three measures are connected, their likelihood of occurrence in the case of COVID 19 is not the same across age groups (Hoffmann and Wolf, 2020), genders (Ahrenfeldt et al., 2020) and countries (Kontis et al., 2020). The variations of the three indicators point out to the convergence of biological, economic, social and political factors, prevalence occurring at the intersection of biological vulnerability (some groups have a higher probability to develop the disease when getting in touch with the virus), direct exposure to the virus (some professions being more exposed), individual behaviour (compliance to containment measures), the measures adopted to contain the spreading of the virus and the response of the healthcare system (Kontis et al., 2020).

Prevalence

The prevalence of COVID 19 varies greatly between men and women and by age group, with women and young people being more likely to get infected (Oosterhoff et al., 2020). There are no proven biological factors exposing women more than men to the risk of infection (Sobotka et al., 2020). Social factors are in play when it comes to the variation by gender: frontline workers, or those spending more time out with friends or people overseeing the rules regarding risk containment are particularly vulnerable. Moreover, gender, age and occupation intersect, leading to higher prevalence among several groups, Sobotka et al (2020) reporting the highest gender gap of infection rate among young women and old men, distribution varying by country.

Social and behavioral factors can influence gender based- differences in exposure to COVID-19 due to employment. A wide range of occupational risks are associated with gender-based differences in exposure to COVID-19. Stay-at-home policies along with social distancing and mandatory quarantine had an impact on the employment in frontline industries and led to economic uncertainty and alteration of home-arrangements for both men and women. These economic changes transferred the burden on women (Voicu and Bădoi, 2020), while previous analyses suggest that women are more likely to work in precarious and lower pay jobs than men (Farre et al., 2020; Collins et al., 2020) and have higher occupational exposure to COVID 19 than men (Sharma et al, 2020). The industries more severely affected by the pandemic are those with a large share of women, such as retail trade and sales (64.6%), food and accommodation services (54%) (ILO, 2020). The 'essential' labour supported by women during the pandemic meant, on one hand, working with atypical arrangements or for partial pay or unemployment which led to economic resilience (Reichelt et al., 2020).

Higher exposure to COVID 19 was observed for all high-risk and frontline jobs (Wenham et al., 2020), such as healthcare. A large proportion of workers in healthcare services are women (70% of the global health workforce and 76% in the European Union) (EIGE, 2019; Boniol et al., 2019). In Romania, about 90% of the total staff in healthcare are women (INSEE, 2018). The rate of infection among healthcare workers was 12.7% in April 2020 (Hâncean et al., 2020), the risk of contagion being higher in women (Vora et al., 2020).

Although women have higher risks of infection due to the "occupational disadvantage" (Sobotka et al., 2020), the gender ratio of infection is not evenly distributed across age groups. According to Sobotka et al (2020), among the population under 60 years old women have a higher infection rate, while among the elderly, men get infected more often. The peak of the distribution differs across countries, in Belgium, Norway, Spain or UK the highest gender ratio being reported among the age groups 20-29 and 30-39 (Sobotka et al., 2020), while in Italy the highest gender ratio is in favour of men of 60 to

80 years old. The study puts the cross-national variation on account of the differences in female employment rate over the life course and childcare commitments. Starting from the assumption that female employment and childcare obligations contribute to the differential exposure of women to the risk of infection, we can expect that the pattern of fertility (mother's age at first birth) moderate the gender ratio across life course. In Romania, the mother's age at first birth is lower as compared to the countries in Western Europe - 26.7 years, compared to 29.9, which is the EU mean (EUROSTAT, 2020), which makes women in their mid-twenties and early thirties less exposed to infection.

Mortality and Case Fatality Rate

Mortality rate refers to the occurrence of deaths within a population, in a given period of time.[1] In the case of infectious diseases, measurements such as infection fatality rate (IFR) and case fatality rate (CFR) are particularly relevant, but the accuracy of these indicators relies heavily on the proper estimation of the number of infected individuals. IFR is an estimation of the number of deaths in reference to all infected individuals, whereas CFR refers to the number of deaths in reference to the confirmed cases of infected individuals (WHO, 2020). IFR relies on predictions and scientifically grounded extrapolations of the *real number* of infected individuals, based on confirmed cases and general knowledge about a certain disease, whereas CFR is based not on estimates, but on the *official number* of infected individuals. In case of COVID 19, the IFR is difficult to assess as many people get infected without developing symptoms and the actual number of infections remains unknown (Collins et al., 2020). Therefore, we consider only CFR, as its computation relies on official statistics.

Mortality is shaped by various individual and societal factors such as age, health condition, gender, occupation, individual socio-economic status, level of economic development and social inequality. Changes in mortality, associated with the constant increase of life expectancy, are characteristic to both demographic transitions (Zaidi and Morgan, 2017). Education is associated with access to resources, better understanding of the environment and one's health. As education level increases, the mortality risk, especially at a young age, decreases (Hummer and Lariscy, 2011; Masters et al., 2012).

Age and health status as risk factors

COVID 19 proved to be particularly harmful for older adults over 65 years old and for those having some pre-existing health conditions, such as diabetes, coronary diseases, arterial hypertension, or obesity (Shah et al., 2020). The existing literature points to the association between population structure and COVID mortality, societies having a large share of elderly reporting high COVID mortality rate (Medford and Trias-Llimos, 2020). In Romania the share of the elderly in total population is quite high, as it is the prevalence of some pre-existing medical conditions. The population at risk of developing severe health conditions due to SARS-COV-2 because of age represents 18.5% of the total population in 2019 (Eurostat, 2020).

[1] https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section3.html

In Romania, 95.6% of people who lost their lives due to COVID 19 suffered from at least one medical condition (NIPH, 2020). The most common such comorbidities are cardiovascular diseases, diabetes, neurological pathologies, kidney disease, obesity, lung disease or neoplasm (Shah et al., 2020). An important share of Romanians has chronic conditions reported to general practitioner. In 2018 about 13296,5 of 100000 inhabitants were under GP supervision for at least one of the following: hypertensive disease, ischemic heart disease, diabetes mellitus, chronic obstructive pulmonary disease, cerebrovascular diseases, ulcerative disease (NIPH, 2018).

According to NIPH (2020), in the age group 20-79 years, the prevalence of chronic conditions at high risk is quite high (hypertension, 45.1%, and diabetes, 12.4%), while ischemic heart disease and stroke are the main causes of death in Romania. The mortality rates caused by these two medical conditions are above the EU average. Comorbidities associated with death from SAR-COV-2 infection are also the most common pathologies encountered in Romania (hypertensive disease, ischemic heart disease and diabetes) (OECD & European Observatory on Health Systems and Policies, 2019). In 2018 about 20% of patients with hypertension were not diagnosed, while the highest risk of developing severe complications was among men of about 50 years old. Diabetes is also more frequent in men (NIPH, 2018).

The burden of the pandemic on healthcare and healthcare services, limited the access to non-emergency/ general health services. By giving priority to the COVID-19 patients, other non-COVID health conditions were considered predictors of increased mortality, especially among men and women after 65 years (Shah et al., 2020), leading to a vicious circle, as those with pre-existing conditions could not get the full medical attention and become more vulnerable to the infection.

Gender as factors of risk for developing severe infection

The literature on COVID-19 pandemic points to sex differences in mortality rates (Betron et al., 2020; Li et al., 2020). The biology of sex is playing a crucial role for the risks of death due to COVID-19. Sex differences in COVID-19 mortality are shaped by biological risks along social factors as social environments, social class differences and gender norms. Biological and social factors are shaping men's health vulnerabilities leading to higher mortality rates among them (Mooney et al., 2020; Jin et al., 2020).

Men's health outcomes are generally poor compared to women (Betron et al., 2020), while high-risk behaviours such as lower compliance to containment rules (social distancing, wearing masks, hand washing) and less concern for preventive healthcare are more frequent among men (Griffith et al., 2020). Prior studies suggest that women are more likely to perform daily routines of hand and body hygiene and to access health preventive services (Sharma et al., 2020). Risk behaviours combined with lower rates of handwashing, alcohol abuses, and smoking are linked to higher risks for developing COVID-19 complications.

Social inequality as risk factor

Socioeconomic disparities involve inequalities of access to resources and services, leading to health inequalities and shaping mortality risk. COVID-19 mortality resembles general mortality (Goldstein and Lee, 2020), not only by mirroring the existing (health) inequalities (Bambra et al., 2020), but also by widening the gap between individuals with different statuses and access to resources. By instance, working from home, although highly recommended for virus containment, is an option only for some jobs: 'The lower people's income, the less likely are they to be in jobs where working from home is possible' (Marmot and Allen, 2020: 682). Therefore, the data about the socio-economic status of those infected would be extremely helpful to control the pandemic (Khalatbari-Soltani et al., 2020).

Life expectancy in poor countries and, respectively, in rich countries differs (Cutler et al., 2006). There are also cohort dependent variations of mortality trends (Link, 2008), as well as life course effects, including the conditions experienced in childhood/ socialization period (Masters et al., 2017). The events along the life course, ascribed or (freely) chosen, are relevant when discussing mortality. Not everyone has the same probability of developing severe infection due to COVID 19, and the risk profile differs depending on several aspects pertaining to the structure of daily life (environment exposure/working conditions, different types of habits – eating choices, smoking etc.). Socioeconomic inequalities are in part responsible for the cross-countries variation of mortality, too: 'the growing gap between the rich and the poor affects the social organization of communities and that the resulting damage to the social fabric may have profound implications for the public's health' (Kawachi et al., 1997: 1497).

Summing up, the risk of developing severe COVID-19 infection deals with age, gender, pre-existing health conditions and social inequality. These factors intersect and overlap leading to high risk for several groups, such in the case of men above 65 years old with several comorbidities.

Method

The paper draws on two types of data: death counts from all causes used to compute the excess number of deaths in 2020; and the number of COVID-19 cases and deaths based on which we calculated: prevalence, mortality, and fatality rates.

The number of excess deaths is the difference between the number of deaths recorded in a certain period of time and the number of deaths expected to occur during that time, based on the average mortality reported for the previous years. There are several ways to estimate the expected number of deaths and we compute it by averaging the number of deaths by age, sex, and week for the years 2015-2019. We use Eurostat data from the week 1 until week 35 of each year because of limited data availability for the year 2020. The data for 2020 are provisional and our computations are only estimates and, although the trend is expected to reflect reality, the actual number must be interpreted with caution.

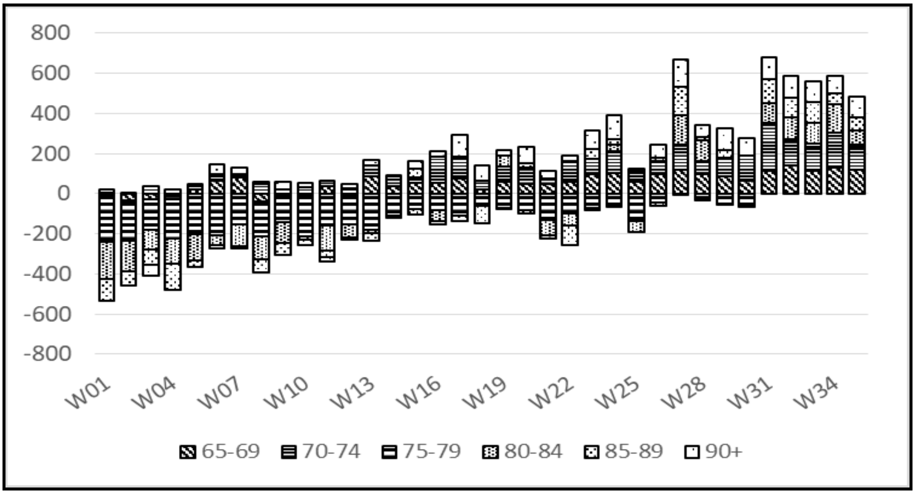
The information about the COVID-19 cases and deaths are based on data extracted from reports published by the National Institute for Public Health (NIPH), which put together weekly summaries of the spread and severity of COVID-19 in Romania. The reports include only charts with the percentage of cases and deaths by age for men and women, so the actual figures were estimated using an application designed for such tasks: WebPlotDigitizer (Rohatgi, 2020). The resulting approximations had to be adjusted so that summing the percentages by sex and week the result should be as close as possible to 100 and summing the estimated number of cases and deaths based on the percentages, the total obtained should be close to the total by sex and week published in the reports.

For the denominator of the prevalence and mortality rates of COVID-19, we used the National Institute of Statistics estimate of resident population reported in January 2020. The rates are reported using the reference of 100 000 people. The CFR is expressed in percentages.

Results. Excess mortality

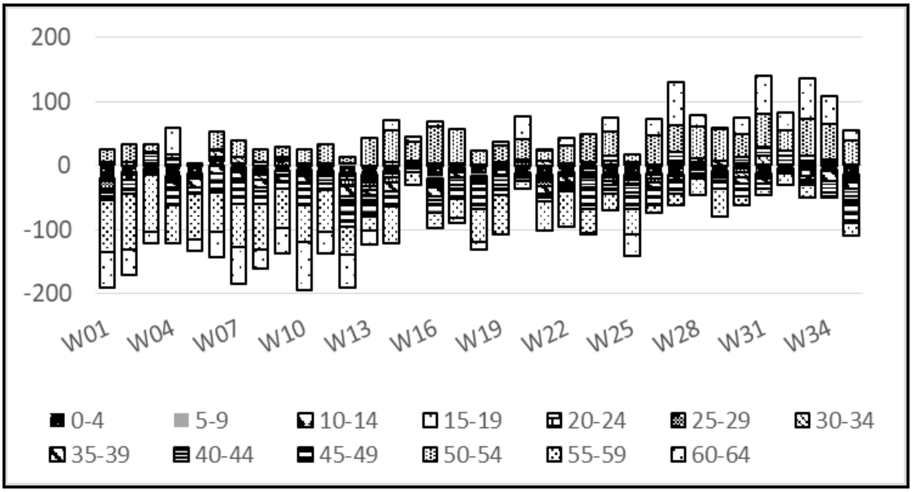
Comparing the first 35 weeks of 2020 (January – August) with the same period of 2015-2019 shows that fewer deaths were reported in the beginning of 2020 with irregular variation. At the beginning of 2020, for most age groups, there were less deaths than expected based on the average of the previous five years, and the trend changed at the end of March. Around week 14 more deaths than expected were registered for people aged 50+, the most affected age groups being 65 to 74. This second stage lasted until the end of June (approximately week 26) only to make room for a third more gloomy period when the value of excess deaths is almost offsetting the gains from the beginning of the year. Although the data series was discontinued at the end of August, most likely the excess deaths continued to increase. Throughout the entire period, people aged 65-74 seemed to have been most affected, while those aged 75 to 84 years were less affected, but the positive trend diminished towards the end of the period.

Figure 1a: Excess deaths by age in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 65+



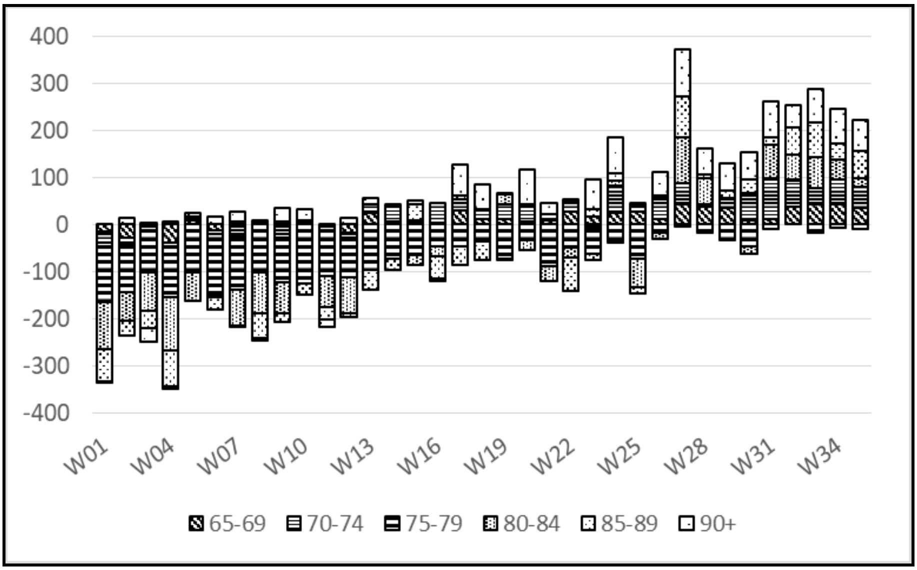
Data source: Eurostat

Figure 1b: Excess deaths by age in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 0-64



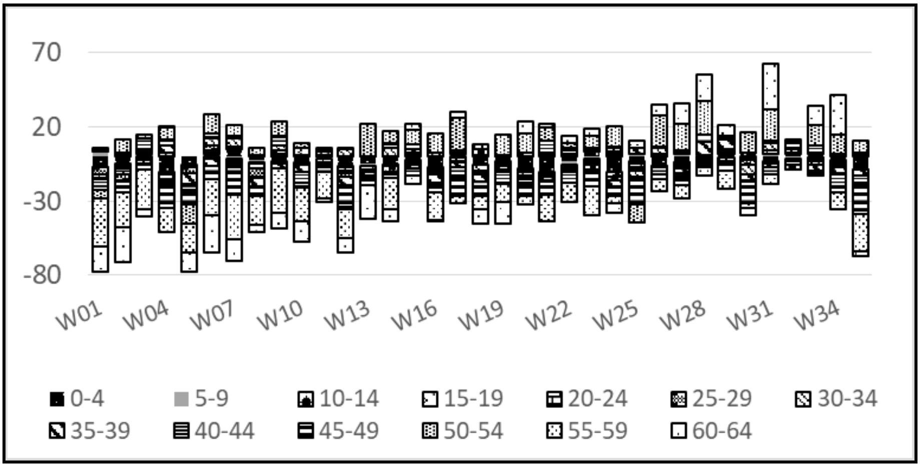
Data source: Eurostat

Figure 2a: Excess deaths by age in the case of women in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 65+



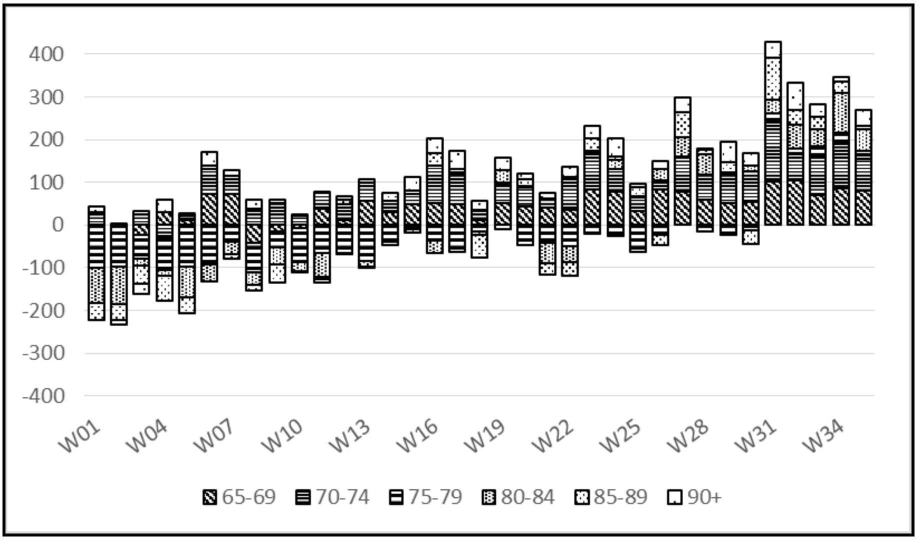
Data source: Eurostat

Figure 2b: Excess deaths by age in the case of women in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 0-64



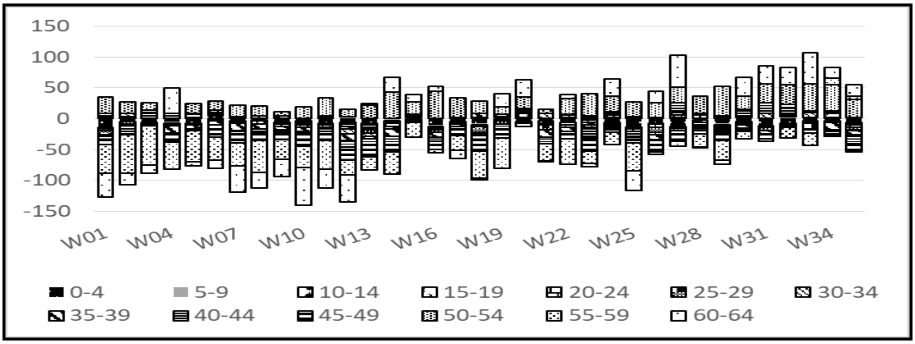
Data source: Eurostat

Figure 3a: Excess deaths by age in the case of men in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 65+



Data source: Eurostat

Figure 3b: Excess deaths by age in the case of men in 2020 compared to the average of 2015-2019 (Week 1 - Week 35), ages 0-64



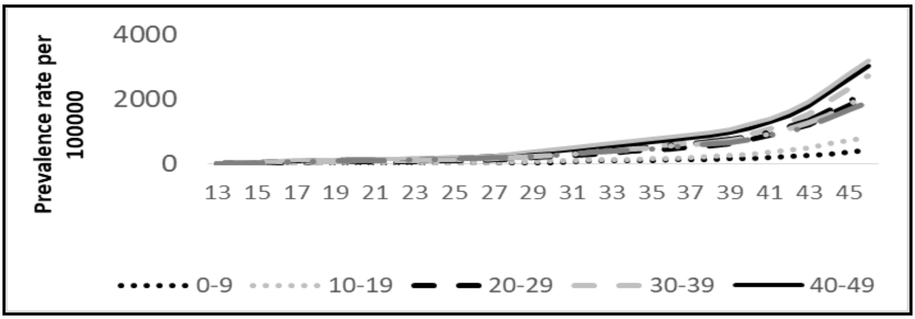
Data source: Eurostat

There are also notable differences between sexes. Excess deaths were recorded for men older than 70 but also for those in the age group 50-54, that are visible from the first week of the year. Men aged 55-64 seem to be at lower risk than women of similar age. Throughout the observed interval, the excess number of deaths in the case of men was higher than the excess in the case of women for age groups 65 to 74 years old.

Results: COVID-19 prevalence, mortality, and fatality

Age-specific prevalence rates, showing the spread of the disease in particular age groups, continuously increased over the observed period. From week 13 to week 30 the increase was rather slow, followed by a much steeper increase particularly for adults and people in old age. The speed accelerated further around week 38. Three patterns of increase in prevalence rates are distinguishable: low prevalence, with slow increase in the case of age groups 0-9 and 10-19 years old; sizable prevalence with high growth rate for the age groups 40-49 and 50-59 years old, with the evolution of the prevalence rate in the other age groups being situated between these categories but closer to the second.

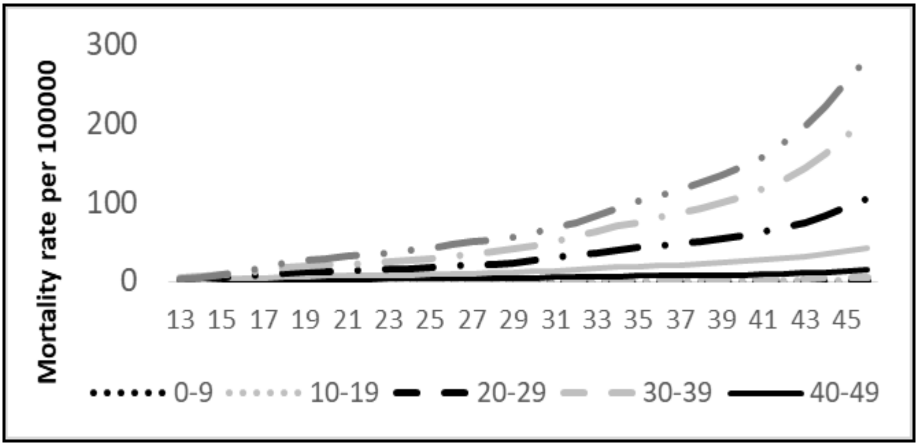
Figure 4: Age specific prevalence rate: week 13 - week 46/2020



Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

There is substantial variation between age groups in terms of prevalence rate of COVID-19. People aged 40-49 and 50-59 seem to be most susceptible to get infected. The highest prevalence of about 3200 cases for 100000 occurs in the age group 50-59. The lowest prevalence, of about 450 cases for 100000 individuals, is registered for the youngest age groups. Most of the other age groups had this prevalence before week 30. People aged 40-59 reached this milestone earlier whereas those aged 20-29 slightly later. Before week 30 several age groups had remarkably similar prevalence: those over 60 years old and those aged 30 to 39. However, as time went by, the variation increased and the prevalence rate in these groups ranges from about 1900 cases/ 100000 (age group 80+) to approximately 2700 cases/100000 (age group 30-39).

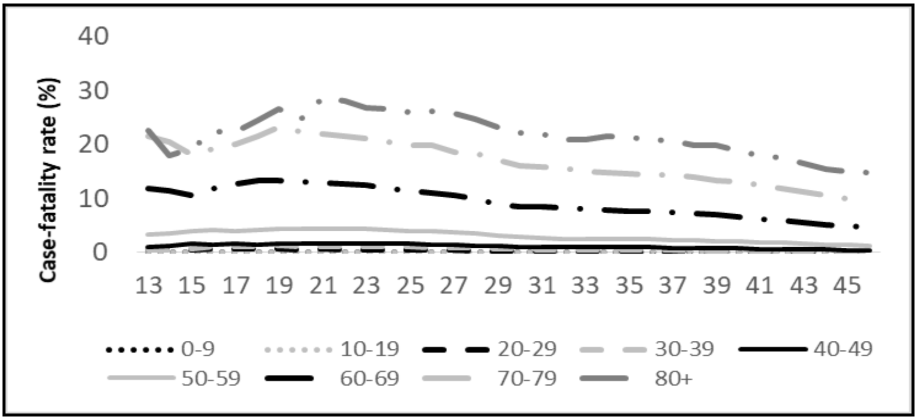
Figure 5: Age specific mortality rate: week 13 - week 46/2020



Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

At first glance, the evolution of the mortality rate is like the pattern of prevalence rates in terms of ascending trend and the increase in growth rate around weeks 30 and 38. However, prevalence of COVID-19 and mortality have different trends in different age groups. While the age group 50-59 knows the highest prevalence, it is the age group of 80+ which has the highest mortality rate. The mortality rate is around 40 per 100000 individuals in the age group 50-59, whereas in the ranks of those aged 80 + it is close to 300 / 100000. For each 100000 individuals aged 80+, almost 300 have died in Romania because of COVID 19 in the first 32 weeks of the pandemic. The data shows that the higher the age, the higher the death rate. Nevertheless, for younger cohorts the values are consistently smaller than for older age groups. Mortality rate varies from 0 to 14 deaths/100000 individuals up to age 49, while individuals aged 50 and over have higher mortality rates.

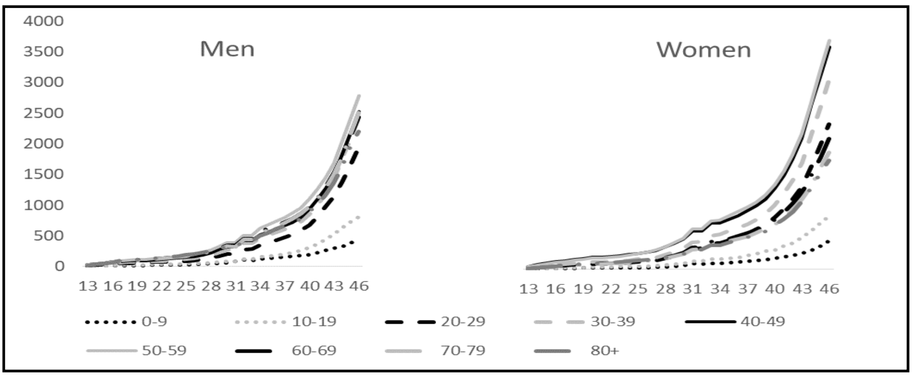
Figure 6: Age specific CFR: week 13 - week 46/2020



Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

CFR provides a more accurate image of the magnitude of the pandemic, given the discrepancy between the dynamic of the prevalence and mortality. The mortality rate has an ascending trend given that it presents the number of deaths relative to the size of the population and the number of deaths has increased continuously since the beginning of the pandemic. The CFR has a different trend compared to the mortality rate, although for both the highest values are recorded for the higher ages. The CFR increased in the first weeks reaching a peak around week 20, decreasing afterwards. The number of deaths among those who got infected decreased at faster pace until week 30 when the decline slowed down and was even slightly reversed in the age group 80+ for around three weeks. The slightly more accentuated decrease after weeks 38 – 40, at least for older ages, suggests that the number of cases increased at a faster pace compared to the number of deaths.

Figure 7: Age specific prevalence rate (per 100000) by sex (week 13 - week 46/2020)

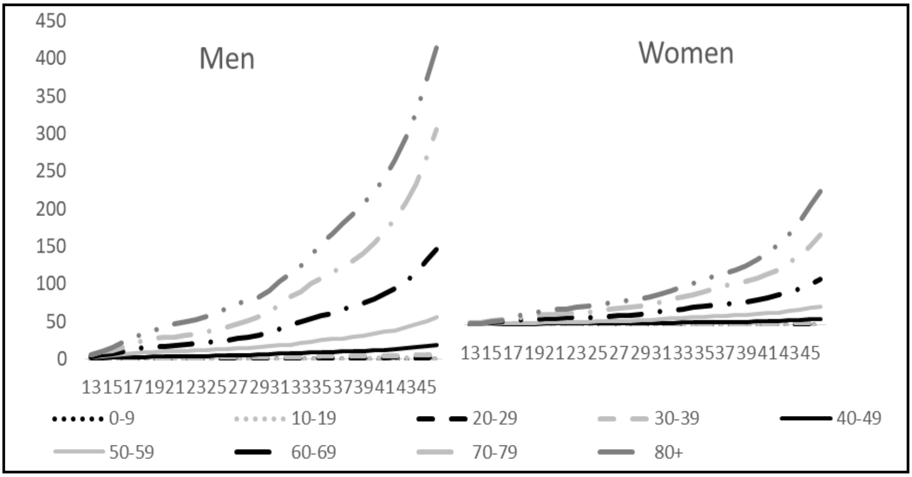


Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

Age specific prevalence rates differ by sex, with the prevalence of women more like the trends described for general population. In terms of size, the prevalence is generally higher for women than for men but varies by age groups. The prevalence rate is higher for women between 10 and 59 years old, the largest difference being reported for the age group 40-49 with around 2100 cases/ 100000 women and approximately 1500 cases/ 100000 men. The prevalence rate is higher for men in the age groups 0-9 and over 60 years old, and the largest difference is reported for those in their 70s, with about 1490 cases/ 100000 men and 1100 cases/ 100000 women.

Apart from the age group 0-19, men and women display different trends in age specific prevalence. Women older than 20 can be divided in two groups. The first group consist of women and 20 to 29 and over 60 years, who have low prevalence and greater homogeneity of patterns. The second group includes women aged 40 to 59, with high prevalence and fast growth. Women in their 30s were more alike to the first group but as the pandemic evolved the prevalence rate grew faster and they resemble the second group. For men such groups are not visible. Most age groups over 20 years old follow a similar trend, except those aged 20-29 for whom the prevalence increased slowly and the age group 50-59 where the prevalence rate increases at times slightly faster. The prevalence rate is generally larger among women, mortality and case fatality rates are in general higher for men.

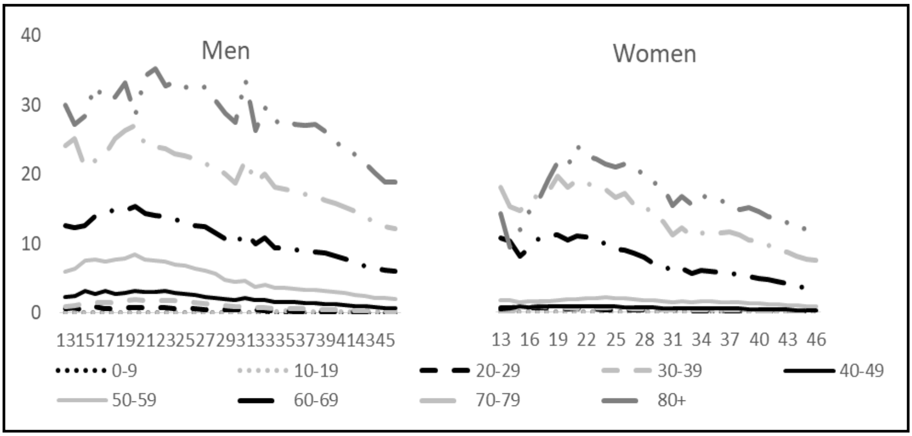
Figure 8: Age specific mortality rate (per 100000) by sex (Week 13 - Week 46/2020)



Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

Age specific mortality rate is higher for men compared to women, and the difference increases with age. The highest mortality rate and the highest gender disparity is found in people over 80 years old, with a mortality rate of 213 deaths/100000 women and 415 deaths/100000 men. The age specific mortality rate increases more steeply for men than for women, indicating that the number of deaths among men increases faster than among women, mainly in old age. The result is not surprising, as all-cause mortality is higher for men than for women across all ages.

Figure 9: Age specific CFR (%) by sex (week 13 - week 46/2020)



Data source: authors' estimates based on NIPH reports; INS 2020 population estimates

Age specific case fatality rate is higher for men than for women. The same peak in terms of deaths relative to cases by sex as we did in the CFR for the general population is visible around week 20. In contrast to the mortality rates, the decreasing trend occurs for men and women. For the same number of people who tested positive for COVID-19, fewer people die by the end of the interval compared to the middle of it (around week 20) regardless of sex. This outcome may occur because the number of cases is increasing at a faster pace compared to the number of deaths. Moreover, the difference between the CFR of men and women decreases from old to young ages. Regardless of gender, the overtime variation of the CFR was larger for people over 60 years old. The men in the age group 50-59 also experienced a larger variation across time compared to women of the same age, with a hump around week 20.

Conclusions and discussion

This paper looks at how the intersection of age and gender shapes the unfolding of the COVID 19 pandemic in Romania in its first 32 weeks, from 30 March to 22 November 2020. Using data retrieved from EUROSTAT and the National Public Health Institute we show that the intersection matters for prevalence, mortality, and fatality. The data point to age and sex related differences, in terms of prevalence, which is higher for women, age specific mortality rate and age specific CFR, that are higher among men. The results suggest an effect given by the intersection of age and gender; such is the case of age specific mortality rate. The infection is more spread among women, particularly among those between 40 and 59 years old, while men pay a higher death toll that is not evenly distributed across age groups.

The higher prevalence among women of 40 to 59 years old is likely due to the occupational exposure of those working in frontline activities, such as health care, care work, education, frontline desks where women are the majority. The pattern in Romania resembles the one reported by Sobotka et al (2020) for Spain and Portugal, with high infection rate among women above 35 years old, as opposed to Norway and the UK, where the infection spreads more among women in their 20s. Further research should look at the pattern of family formation and mother's age at first birth, as possible explanations for the differences across countries.

Men overpass women when it comes to COVID-19 death toll in Romania in the first 32 weeks of the pandemic. The data on excess mortality points to higher growth of excess death among men belonging to the age group 65- 74. For women, the excess mortality is concentrated in the oldest age groups 80+, resembling general mortality, which grows with age. As it seems that the excess mortality in 2020 follows a different pattern for those of 65 to 74 years old, further research should look at how the pattern of mortality and fatality evolves by gender and age groups and to find out whether this deviation is related to biological reasons or is the outcome of the intersection between social and biological factors. Over time analysis and cross-national comparison can shed light on the causes of this pattern.

As information regarding the individuals infected with SARS-Cov-2 are limited, the influence of life course or socioeconomic inequalities on prevalence or fatality is hard to assess. Both socioeconomic inequalities and life course bear influence when it comes to the propensity of developing severe complications and further research should look closer to the impact of their intersection on the unfolding of the pandemic.

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Declaration of conflicting interests

We declare, on our responsibility, that there is no conflict of interest in the production and publication of this article.

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