An intersectional perspective on gender/sex disparities in the epidemiology of COVID-19 cascade from testing to mortality: Evidence from Swiss surveillance data

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ABSTRACT

Objectives This study investigates sex and gender disparities in COVID-19 epidemiology in the Canton of Vaud, Switzerland, focusing on interactions with socioeconomic position (SEP) and age.

Methods We analyzed COVID-19 surveillance data from March 2020 to June 2021, using an intersectional approach. Negative binomial regression models assessed disparities between women and men, across SEP quintiles and age groups, in testing, positivity, hospitalizations, ICU admissions, and mortality (Incidence Rate Ratios [IRR], 95% Confidence Intervals [CI]).

Results Women had higher testing and positivity rates than men, while men experienced more hospitalizations, ICU admissions, and deaths. The higher positivity in women under 50 was mitigated after accounting for higher testing rates. Within SEP quintiles, gender/sex differences in testing and positivity were insignificant. In the lowest quintile, women's mortality risk was 68% lower (IRR 0.32, CI 0.20-0.52), with no significant disparities in the highest quintile (IRR 0.66, CI 0.41-1.06).

Conclusion Our findings underscore diverse epidemiological patterns of COVID-19, shaped by the interactions of gender/sex, SEP, and age, highlighting the need for intersectional perspectives in both epidemiological research and the development of public health strategies.

Keywords (5-8) *COVID-19 epidemiology; Gender and sex; Social determinants of health; Intersectionality; Public health strategy*

INTRODUCTION

The COVID-19 pandemic had heterogeneous impacts, with certain populations being disproportionately affected. The literature on COVID-19 indicates that socioeconomically disadvantaged groups face higher risks of contracting the virus and experiencing severe outcomes, such as hospitalization and mortality (1-5). This association is linked to socioeconomic determinants, where limited income and education create conditions that elevate exposure risk and susceptibility to infection (1). In Switzerland, studies have highlighted socioeconomic disparities in the COVID-19 cascade, both nationally (5) and regionally (4), revealing that neighborhood-level socioeconomic vulnerability shapes these disparities (6). Additionally, substantial gender differences, particularly in labor and family domains, affect individuals over their lifespan, contributing to gendered socioeconomic inequalities that impact health (7).

Globally, men were more likely to develop severe forms of COVID-19, resulting in higher hospitalizations and mortality rates compared to women (8-14). The origins and pathways of these disparities lie in a complex interplay of gender-specific social processes and sex-specific biological attributes. Gender, a multifaceted construct embedded in societal norms and structures, significantly influences life experiences based on sex assigned at birth (15). Gender inequalities in health arise from the intricate interaction of multiple factors, including differential exposure to health risks, health-related behaviors, access to healthcare, and gender biases in healthcare and research (15, 16). Early public health responses, like social distancing and mask wearing, aimed at modifying individual behaviors to reduce transmission risks (17, 18). Yet, gender-based differences in adherence to these behaviors were reported (17). Sex-related biological differences, such as hormonal levels, can influence the body's response to infection (17, 19, 20). Studies have suggested that hormones like oestrogens and progesterone, typically higher in women, might offer protection against viral infections, while testosterone, predominant in men, could have the opposite effect (21, 22). Furthermore, men often exhibit higher ACE-2 receptor levels, used by SARS-CoV-2 to enter cells, potentially explaining the more severe infection cases (17, 21, 23). However, women seem more susceptible to long-lasting COVID-19 symptoms, or "long COVID", possibly linked to variations in immune responses and sex hormones (17, 21, 24).

The convergence of socioeconomic vulnerabilities, the local context, and gender and sex -related factors, underscores the need for an intersectional perspective in understanding the pandemic's impact. Intersectionality, originally rooted in race/class/gender studies (25), considers the interplay of multiple social determinants affecting health outcomes in complex and non-additive ways (15). It recognizes the heterogeneity within women’s and men’s groups, with health outcomes varying significantly based on their age, ethnicity, socioeconomic status, along other major health determinants (26). The significant variations in the influence of gender and sex

across socioeconomic conditions and over the lifespan highlight the importance of an intersectional approach to deepen our understanding of COVID-19 epidemiology (21, 24). This study analyzes surveillance data from the canton of Vaud, located in Switzerland's French-speaking region. Its primary objective is to explore gender and sex disparities in the COVID-19 epidemiology cascade, including testing, test positivity, hospitalization, intensive care unit (ICU) admission, and mortality. We examined these disparities in the context of key social determinants of health, focusing on neighborhood-based socioeconomic position (SEP) and age, through an intersectional analytical approach. We aim to uncover the complex dynamics underlying these disparities and enhance our understanding of COVID-19's broader epidemiology. Such knowledge, considering gender and sex influences, vulnerabilities, and diverse social determinants of health is crucial for developing equitable and efficient strategies to mitigate COVID-19 and inform future pandemic responses (21).

METHODS

Data

This observational retrospective study focused on the analysis of COVID-19 surveillance data from March 2020 to end of June 2021 of the population residing in the canton of Vaud. Within the Swiss federal system, the Federal Office of Public Health (FOPH) oversees the monitoring transmissible diseases, including COVID-19, in collaboration with cantonal authorities, through mandatory reporting of infectious diseases (18). Entities authorized to conduct SARS-CoV-2 testing (RT-PCR and rapid antigen tests), such as general practitioners, pharmacies, and testing centers, were mandated to notify each test (negative and positive) to the FOPH. Hospitalizations (lasting at least 24 hours) and ICU admissions due to COVID-19 were reported by hospitals in Vaud canton. COVID-19-related deaths among cases classified as probable or confirmed were also reported to cantonal health authorities (see Supplementary Table S1 for case definitions). Population data, as of December 31, 2020, were obtained from the cantonal office of statistics (27). The SEP of notified individuals was determined using the Swiss-SEP, an area-based indicator (28, 29). Detailed information on the geocoding procedures is provided in Supplementary Section 2.

The first epidemic wave in Switzerland occurred from February to end of May 2020, and was characterized by low testing capacities, due to restricted access to SARS-CoV-2 RT-PCR tests (4, 5). The tested population primarily included symptomatic individuals, those with known risk factors (e.g., people with comorbidities), and healthcare workers (4). Testing expanded from June 24, 2020, to include mildly symptomatic individuals and close contacts of infected individuals, with test costs reimbursed (5). In December 2020, COVID-19 vaccines became available, initially prioritizing vulnerable populations and gradually extending to others, with vaccination centers

opening on January 11th (18, 30). By the end of June 2021, 85% of those aged 75 or older, and 53% of those aged 18 to 49 had received at least one vaccine dose (31).

The data analyzed covered a period of 69 weeks from March 2, 2020 (first notified cases in Vaud canton), to June 27, 2021, as the cantonal hospital's surveillance system ceased on June 30th, 2021. due to inconsistent negative test reporting prior to May 24th, 2020, the dataset for the total number of tests spans only 57 weeks. Notifications included the date, test result (positive, negative), the reported gender/sex of the individual (categorized as woman, man, or other), which could align with administrative sex, attributed sex, or self-reported gender identity, date of birth or age, and residential address.

Duplicated notifications, records with invalid residential addresses, and those missing age or gender/sex information were excluded. Additionally, notifications with "other" as gender/sex (0.001% of total tests) were excluded. Age was grouped into nine categories of 10-year age bands and 80 and above. For hospitalizations, ICU admissions, and deaths, ages 0 to 59 years were combined due to low event occurrences in this range.

In this paper, we use the term "gender/sex" in acknowledgment of the complex and intertwined nature of gender and sex from a theoretical perspective (32). This terminology also aligns with our use binary "women/men" categories, which could correspond to administrative sex or to reported gender identity, depending on the notification form process used for data collection. Finally, from a methodological perspective, this gender/sex variable serves as a proxy potentially capturing both gender-related aspects (e.g. behaviors) and sex-related biological factors (e.g. hormonal variations) effect on the outcomes of interest.

The Swiss socio-economic position (Swiss-SEP)

The Swiss-SEP is an area-based socio-economic position index centered on residential buildings, encompassing overlapping boundaries. The Swiss-SEP considers neighborhood information based on an average of 50 households (29) (detailed in Supplementary Section 3). Based on the 2000 census and 2012-2015 annual micro-census, it is based on indicators such as median rent per square meter (income), education level of household heads, occupation type, and crowding (28). There are 115'596 SEP neighborhoods within the geographical boundaries of Vaud canton.

Residential coordinates of each notification were matched with the nearest SEP neighborhood. The SEP index values were categorized into quintiles from one (lowest) to five (highest). Non-residential addresses, such as schools or nursing homes, and addresses with only ZIP code information, were assigned the average SEP of their ZIP code area. Hospitalization and ICU admission notifications, which only contained ZIP code information, were not assigned a SEP. Death notification that could not be geocoded were also excluded in analysis requiring SEP

attribution (See Supplementary Table 4 for descriptive statistics on residential address status by outcomes).

Statistical analysis

Descriptive statistics were employed to evaluate the distribution of notifications by gender/sex, age groups, and SEP quintiles. Incidence rates of tests, positive tests, hospitalizations, ICU admissions, and deaths were calculated weekly per 100,000 population, stratified by gender/sex categories. Cumulative incidence rates over the study period were similarly computed. Negative binomial regression models were used to examine the incidence rate ratios (IRR), with 95% confidence intervals (CIs), between women and men across different age groups and SEP quintiles, by incorporating interactions with gender/sex. These models, which can handle overdispersion of residuals, included denominators as offsets, with the general population as of December 31, 2020, serving as the base for all outcomes. Specifically for positive tests, an additional model using the total number of tests as the denominator was formulated to investigate sex-specific test positivity ratios. A similar methodology was adopted for ICU admissions, with hospitalizations serving as the offset. Sensitivity analyses were conducted on death notifications, initially incorporating notifications from non-residential locations, followed by a comprehensive analysis of all death notifications, including those not precisely geocoded (Supplementary Figures 8 and 9). Statistical analyses were conducted using R statistical software (33), and negative binomial models estimated using the MASS package (34). This research aligns with the Sex and Gender Equity in Research (SAGER) guidelines (35).

RESULTS

[Table 1 – descriptive statistics]

In 2020, the population of Vaud included 815’300 residents, comprising 412’599 women (50.6%) and 402’701 men (49.4%) (Table 1). From the onset of the pandemic in March 2020 to the end of June 2021, a total of 885’925 SARS-CoV-2 tests, 96’963 positive tests, 6’356 hospitalizations, 1’134 ICU admissions and 1’175 deaths (prior to the exclusion of non-geocoded death notifications) met eligibility criteria (see flow chart in Supplementary Figure 5). Although women accounted for a higher number of tests and positive results, a majority of hospitalizations, ICU admissions, and deaths occurred among men.

In Vaud population, 38% of women and 34% of men were aged 50 and above. Among women, this age group accounted for 33% of all tests and 38% of positive tests. However, a larger proportion of severe outcomes was attributed to this age group, accounting for 80% of hospitalizations, 89% of ICU admissions, and 99.8% of deaths. Similarly, among men, those aged

50 and older made up 32% of tests, 39% of positive tests, 86% of hospitalizations, 91% of ICU admissions, and 99.4% of deaths

The proportion of total tests that concerned people in the lowest socioeconomic quintile (Q1) was 17% for women and 18% for men, while 21% of tests occurred in the highest quintile (Q5), both for women and men. Regarding positive tests, 21% were recorded in the lowest quintile for women and 20% for men, with 18% in the highest quintile, both for women and men. When examining mortality, 18% of men were categorized in the lowest quintile, and 14% in the highest quintile. Among women, 12% of the deaths occurred in Q1 and 15% in Q5.

[Fig. 1 – Weekly incidence rate overtime]

The weekly incidence of outcomes per 100'000 varied differently in women and men over the study period (Figure 1). Women had higher incidence rate of tests and positive tests compared to men, especially during the second wave of the pandemic. Regarding severe outcomes, men had higher incidence rates of hospitalizations and ICU admissions throughout the study period, although the difference with women was less pronounced in cases of death. The third wave had high testing rates, but comparatively lower incidence of severe outcomes and positivity.

[Fig. 2 – Cumulative incidence across SEP and age groups]

The cumulative incidences of outcomes across age groups, gender/sex categories, and SEP quintiles revealed distinct patterns (figure 2). Individuals aged between 20 and 39 were the most tested, while children below 10 was the least tested group. Testing rates were higher for people aged 80 and above compared to those aged 60-69 and 70-79. Similar patterns emerged across age groups concerning positivity. For severe outcomes, prominent age-related trends were observed, with older age groups experiencing higher incidence rates, except for ICU admission rates among individuals aged 80 and above. Men experienced higher incidence rates of hospitalization, ICU admission, and death than women.

When examining COVID-19 cumulative outcomes across SEP quintiles (figure 2, panel B), the cumulative incidence of testing rose progressively from the lowest quintile to the highest. For the cumulative incidence of positive tests, the three lowest SEP quintiles demonstrated similar rates, and comparatively lower rates were observed in the two highest quintiles. A consistent pattern was observed in which women consistently exhibited higher cumulative incidence of tests and positive tests across all quintiles, except in the highest quintile where positivity incidence was similar for both women and men. As for death notifications, men's cumulative mortality rate seemed to decrease from lowest to highest SEP, while for women, the mortality rate was the lowest int the first and in the fourth quintiles. Men displayed higher mortality rates across all SEP quintiles, except in the second.

[Fig. 3 – IRR of tests and positive tests]

Regression analyses revealed distinct testing patterns between women and men across age groups. Notably, women aged 20-29 (IRR 1.14, CI 1.07-1.22) and 30-39 (IRR 1.16, CI 1.09-1.24) displayed a significantly higher likelihood of undergoing testing compared to men in the same age groups (Figure 3, left panel). Conversely, girls under 10 (IRR 0.91, CI 0.85-0.97) and women aged 60-69 (IRR 0.92, CI 0.86-0.98) and 70-79 (IRR 0.85, CI 0.80-0.91) were less likely to get tested compared to their male counterparts. For incidence of positive tests per population, similar gender/sex trends were observed across age groups (Figure 3, center panel). However, most disparities disappeared when taking into account the initial gender/sex differences in testing, as indicated by the regression results of positive tests per test (Figure 3, right panel). An exception was observed among individuals aged 60 and older, where women were less likely to test positive per test compared to men. Specifically, women had an IRR of 0.92 (CI 0.86-0.98) in the 60-69 age group, 0.89 in the 70-79 age group (CI 0.82-0.95), and 0.83 among those aged 80 and older (CI 0.86-1.00), meaning that if tested their test was less likely to be positive compared to men. Moreover, when comparing women and men in similar SEP quintiles (Figure 3, red coefficients), no statistically significant differences in testing and testing positive were found, except for women in the third SEP quintile who presented a slightly reduced probability of testing positive per test compared to their male counterparts.

In regression models without an interaction term for gender/sex categories (Supplementary Table 6), individuals in the highest quintile were notably more likely to undergo testing (IRR 1.25, CI 1.19-1.30) compared to those in the lowest quintile, the reference group. Conversely, individuals in the highest quintile showed a decreased likelihood of testing positive per population (IRR 0.89, CI 0.85-0.95) and testing positive per test (IRR 0.71, CI 0.68-0.74).

[Fig. 4 – IRR of hospitalisations]

Regression analysis in models without an interaction term by gender/sex (Supplementary Table 6), confirmed that age is the strongest predictor for hospitalisations, ICU admissions and deaths, increasing age being associated with higher likelihoods of these events. As depicted in Figure 4, Panel A, although women exhibited lower probabilities of COVID-19 hospitalization than men across all age cohorts, the differences were not statistically significant. The IRR for women up to 59 was 0.80 (CI 0.52-1.22), 0.49 (CI 0.18-1.36) for those 60-69, 0.50 (CI 0.18-1.38) for the 70-79 age group, and 0.58 (CI 0.21-1.61) for those 80 and above. Statistical significance was achieved in the under-60 cohort, where women had a 55% decreased risk of ICU admission (IRR 0.45, CI 0.23-0.86).

Women consistently showed a lower risk of ICU admissions compared to men when hospitalized, as shown in Figure 4, Panel B. Women under 60 presented an IRR of 0.59 (CI 0.44-0.78),

denoting a 41% lower risk. In the 60-69 age group, the IRR was 0.71 (CI 0.49-1.01), with the risk reduction becoming more pronounced with advancing age. Women aged 70-79 had an IRR of 0.62 (CI 0.43-0.88), while those aged 80 and over had an IRR of 0.56 (CI 0.37-0.85), mirroring the risk reduction observed in the youngest age group.

[Fig. 5 – IRR of deaths]

In the context of mortality, regression models lacking a gender/sex interaction term (Supplementary Table 6) indicated that individuals in the highest socioeconomic position (SEP) quintile had a lower likelihood of death (IRR 0.71, CI 0.54-0.95) compared to those in the lowest quintile. This association persisted in the sensitivity analysis that included nursing home residents and was robust when extended to include non-precisely geocoded death notifications (Supplementary material S7). Disparities in mortality favoring women were noted across all age groups, with statistical significance observed in all but the under-60 age group (figure 5). Women demonstrated a reduced mortality risk compared to men of 55% when aged 60-69 (IRR 0.45, CI 0.23-0.88), 58% at ages 70-79 (IRR 0.42, CI 0.30-0.59), and 45% for those aged 80 and above (IRR 0.55, CI 0.46-0.66). Regarding SEP, the gender/sex disparities in mortality were more pronounced in the lowest quintile, with women having a 68% reduction in mortality risk (IRR 0.32, CI 0.20-0.52); and these disparities were not statistically significant in the second and highest quintile.

Investigating the interplay between the three covariates—gender/sex, age, and SEP—using a triple interaction term in populations aged 70-79 and 80+ (Supplementary F S8) revealed that the gender/sex mortality gap diminished with increasing SEP.

DISCUSSION

In the resident population of the Canton of Vaud, Switzerland, our analysis showed that women contributed to a higher number of COVID-19 tests and positive tests than men, whereas more hospitalizations, ICU admissions, and deaths occurred among men. This finding underscores a significant gender/sex disparity in the pandemic's health impact and suggests the need to explore underlying causes, including potential biological differences, behavioral patterns, and occupational exposures.

Individuals residing in the highest SEP neighborhoods were more inclined to undergo COVID-19 testing than those in the lowest SEP areas, with a concomitantly lower likelihood of testing positive and reduced risk of mortality. These observations suggest significant socio-economic influences on health-related behaviors and resource access and utilisation. Our intersectional analysis revealed that these disparities in testing and positivity were similar for women and men when living in neighborhoods with comparable SEP. Nevertheless, the pronounced gender/sex

disparities in mortality across SEP quintiles shed light on the intricate interaction between socioeconomic factors and gender/sex in the trajectory of COVID-19.

Moreover, age-related variations in SARS-CoV-2 testing rates between women and men were evident in our data. Women aged 20-29 and 30-39 had higher testing rates than men in corresponding age groups, but this trend was reversed in both younger and older cohorts, particularly those aged 60-69 and 70-79. These variations suggest a nuanced relationship between age, gender/sex, and health-seeking behavior, necessitating further investigations.

Our study corroborates the well-established correlation between age and severe COVID-19 outcomes, with older age being associated with higher risks of hospitalization, ICU admissions, and mortality. The data also support that men are at an increased risk of severe outcomes compared to women, aligning with previous research (36-38). However, gender/sex disparities in hospitalization and ICU admissions were not significant when examining similar age groups, except for women under 60, who had a lower risk of ICU admissions than men. Interestingly, women under the age of 60 and those aged 70 and above had a reduced risk of ICU admissions when hospitalized, potentially indicating variations in disease progression, differential in access to care or in treatment modalities between women and men.

Our findings are consistent with existing literature (1-5), highlighting the increased vulnerability of individuals residing in low SEP neighborhoods. This vulnerability likely results from a combination of factors, including limited access to healthcare, higher exposure risks due to living and working conditions, occupational hazards, as well as lifestyle habits. These social determinants of health were found to contribute to the observed disparities (3, 39, 40). Moreover, gender/sex differences in testing rates and positivity appeared consistent across all SEP quintiles, suggesting that socioeconomic factors play a dominant role in health behaviors and outcomes, regardless of gender/sex. This insight is fundamental in shaping public health strategies that should address the systemic social inequalities, that the pandemic has further exacerbated (3, 41).

As extensively documented in the literature and corroborated by our findings, men experience higher mortality rates related to COVID-19 compared to women (8, 9, 11-13, 22, 42, 43). This disparity likely arises from a combination of biological and gendered social factors. Gender/sex disparities in mortality across SEP quintiles were outlined, particularly marked in the lowest SEP neighborhoods. This observation suggests that men from socioeconomically deprived backgrounds may encounter cumulative disadvantages that amplify their health vulnerabilities throughout their lives (44). Biological sex-related factors are thought to play a significant role in men's increased vulnerability to COVID-19, possibly mediated through hormonal and immune response (22, 45). Mortality is also influenced by gendered practices and societal norms such as expressions of masculinity, which intersect with various social determinants of health (45). These

include working in hazardous industries, engagement in risky health behaviors, and a higher prevalence of chronic diseases (17, 21, 22, 46, 47), which are more common in socioeconomically disadvantaged populations (39). Another potential explanation may be related to the concept of immune imprinting, stating that past exposure to coronaviruses plays a key factor in the risk of infection and severe forms of infection (e.g., (48)). Because of gender/sex differences in profession and care responsibility, generally involving more contacts with young children and thus with respiratory viruses, women's immune landscape with regards to coronaviruses may differ from men's, influencing the risk of a severe forms of COVID-19. Further research is required in this area.

Age is a key factor in understanding COVID-19 gender/sex disparities. The influence of gender norms on health outcomes varies across the life course (15, 21, 24), and the disparities in testing rates between men and women across different age groups likely reflect evolving societal roles and responsibilities (49). In the 20 to 40 age range, where gender differences in testing were most pronounced, distinctions in family and employment domains are generally observed. Women are more likely to work in essential service sectors involving close contacts and limited telecommuting options, such as in service and healthcare jobs (45, 49-51), which may account for their higher testing rates. Yet, this potential increased exposure did not translate into higher positivity rates when accounting for initial differences in testing, possibly due to greater adherence to health recommendations and protective measures among women compared to men (17, 22, 43, 51, 52). Additionally, women in this age group often bear a disproportionate burden of unpaid care responsibilities, likely influencing their decisions regarding COVID-19 testing (22, 53). The observed higher testing rates in men aged 60 and above may be attributed to the preferential ascertainment of severe cases (54), where individuals who are more likely, or are perceived as more likely, to suffer from severe forms of infection have a higher propensity to get tested. Although the ratios of positive tests were generally similar between genders, women aged 60 and above were markedly less likely to test positive per test conducted compared to their male counterparts, highlighting possible differences in exposure or disease progression.

Our study's strengths include employing a neighborhood-based SEP indicator to capture potential individual and place-level effects on outcomes, and the minimization of selection bias by using comprehensive surveillance data for the entire Canton of Vaud population. However, our analysis is limited by the absence of data on key individual-level factors such as migration status or ethnicity, which could enrich our understanding. This especially considering that approximately one-third of Vaud's population in 2020 had non-Swiss nationality (27), and that ethnic groups have experienced higher exposure and increased vulnerability to COVID-19 (55-57). An additional limitation is hospitalization and ICU admission data, which may be subject to underreporting due to challenges associated with identifying primary causes of hospitalization,

especially among older adults with comorbidities (58). Moreover, deaths occurring outside clinical settings frequently remain untested, complicating their classification as COVID-19 related (58, 59). Additionally, the reliance on residence location for the Swiss-SEP indicator might not accurately reflect lifelong SEP, a common challenge with area-based indicators (60).

In conclusion our study underscores the importance of an intersectional approach in the epidemiological analysis of COVID-19. It not only expands our understanding of the pandemic's varied impacts across different sociodemographic groups but also underscores the importance of adopting intersectional methods in future epidemiological research. This approach is crucial for developing more effective and equitable health responses. Additionally, our findings highlight the necessity for public health policies and healthcare strategies that are responsive to the complexities of these interactions. Finally, addressing broader social inequalities seem essential in reducing the adverse consequences of COVID-19 and improving overall population health.

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Table 1 Distribution of age and socioeconomic position (SEP), stratified by gender/sex categories, Canton of Vaud surveillance data, from March 2nd *, 2020 to June 27th, 2021, Switzerland

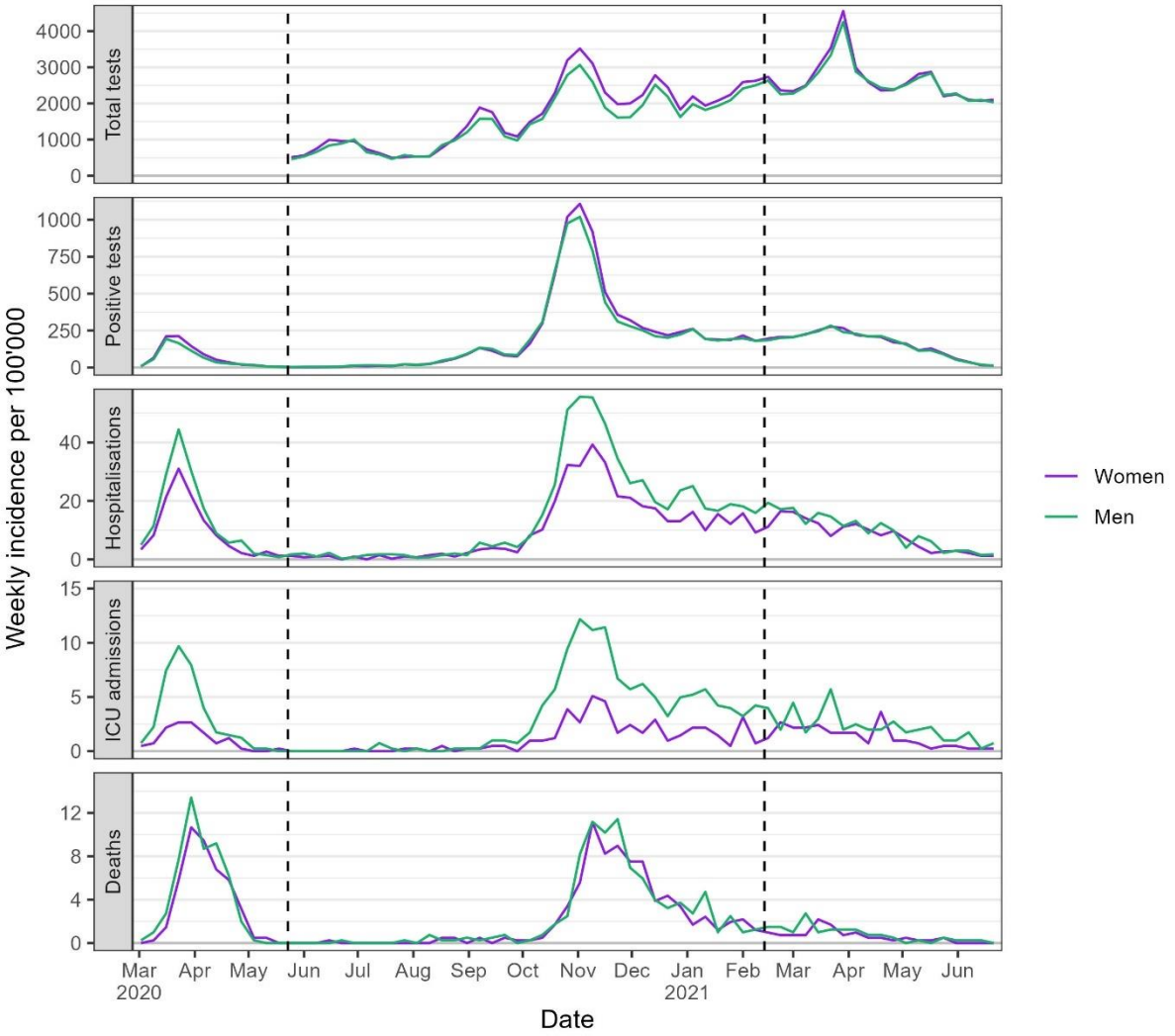
	Population (N=815'300)		Total tests* (N = 885'925)		Positive tests (N = 96'963)		Hospitalisations (N = 6'356)		ICU admissions (N = 1'134)		Deaths (N = 1'175)	
	Women N = 412'599	**Men N = 402'701**	**Women N = 463'105**	**Men N = 422'820**	**Women N = 50'296**	**Men N = 46'667**	**Women N = 2'720**	**Men N = 3'636**	**Women N = 334**	**Men N = 800**	**Women N = 558**	**Men N = 617**
Age groups												
0-9	42'502 (10%)	44'319 (11%)	10'675 (2.3%)	12'225 (2.9%)	620 (1.2%)	649 (1.4%)	30 (1.1%)	31 (0.9%)	0 (0%)	1 (0.1%)	0 (0%)	0 (0%)
10-19	44'291 (11%)	47'101 (12%)	47'039 (10%)	47'542 (11%)	4'644 (9.2%)	4'743 (10%)	50 (1.8%)	48 (1.3%)	1 (0.3%)	1 (0.1%)	0 (0%)	0 (0%)
20-29	52'178 (13%)	54'565 (14%)	84'209 (18%)	76'947 (18%)	8'854 (18%)	7'987 (17%)	128 (4.7%)	69 (1.9%)	8 (2.4%)	5 (0.6%)	0 (0%)	1 (0.3%)
30-39	59'329 (14%)	59'317 (15%)	94'883 (20%)	81'253 (19%)	8'799 (17%)	7'896 (17%)	173 (6.4%)	121 (3.3%)	13 (3.9%)	12 (1.5%)	0 (0%)	0 (0%)
40-49	59'869 (14%)	58'157 (15%)	74'146 (16%)	67'652 (16%)	8'410 (17%)	7'387 (16%)	160 (5.9%)	250 (6.9%)	15 (4.5%)	52 (6.5%)	1 (0.3%)	1 (0.3%)
50-59	57'692 (14%)	56'987 (14%)	62'506 (13%)	59'343 (14%)	7'692 (15%)	7'494 (16%)	299 (11%)	541 (15%)	60 (18%)	147 (18%)	3 (0.9%)	5 (1.3%)
60-69	40'758 (9.8%)	38'247 (9.6%)	36'464 (7.9%)	37'232 (8.8%)	4'260 (8.5%)	4'734 (10%)	384 (14%)	740 (20%)	88 (26%)	238 (30%)	13 (4.1%)	27 (6.8%)
70-79	34'053 (8.2%)	27'488 (6.9%)	25'042 (5.4%)	23'742 (5.6%)	2'967 (5.9%)	3'170 (6.8%)	542 (20%)	873 (24%)	93 (28%)	242 (30%)	54 (17%)	103 (26%)
80+	24'246 (5.8%)	14'201 (3.5%)	28'141 (6.1%)	16'884 (4.0%)	4'050 (8.1%)	2'607 (5.6%)	954 (35%)	963 (26%)	56 (17%)	102 (13%)	246 (78%)	259 (65%)
Quintile of SEP											**N = 317**	**N = 396**
Q1 (lowest)	83'022 (20%)	80'913 (20%)	79'987 (17%)	74'721 (18%)	10'334 (21%)	9'382 (20%)	*NA*	*NA*	*NA*	*NA*	50 (16%)	92 (23%)
Q2	82'756 (20%)	80'512 (20%)	88'181 (19%)	80'457 (19%)	10'560 (21%)	9'708 (21%)					78 (24 %)	72 (18%)
Q3	82'951 (20%)	80'319 (20%)	95'105 (21%)	83'934 (20%)	10'649 (21%)	9'935 (21%)					69 (22%)	88 (22%)
Q4	83'236 (20%)	79'726 (20%)	101'244 (22%)	92'853 (22%)	9'927 (20%)	9'226 (20%)					56 (18%)	77 (20%)
Q5 (highest)	82'953 (20%)	78'912 (20%)	98'588 (21%)	90'855 (21%)	8'826 (18%)	8'416 (18%)					64 (20%)	67 (17%)

Notes: n (%); SEP = socioeconomic position; *NA* = Not Applicable. Death's distribution across SEP quantiles only includes geocoded notifications. * For total tests, period goes from May 27th, 2020, to June 27th, 2021.

Figures

[Fig. 1 – Weekly incidence rate overtime]

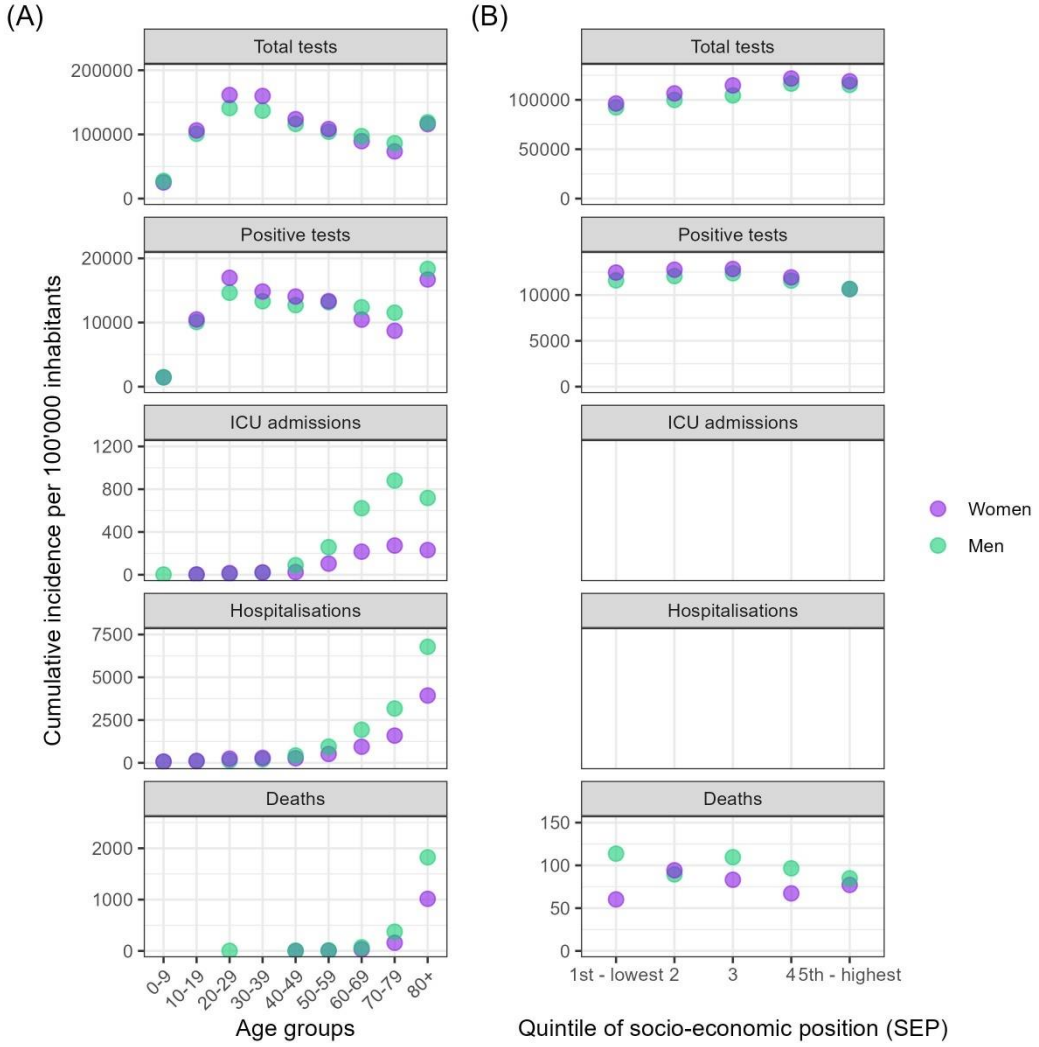
Figure 1 – Weekly incidence of COVID-19 outcomes per 100'000, stratified by gender/sex, Canton of Vaud surveillance data 2020-2021, Switzerland



1st Wave (W1): 1st March-23th May 2020
2nd Wave (W2): 24th May 2020-13th February 2021
3rd Wave (W3): 13th February-26th June 2021

[Fig. 2 – Cumulative incidence across SEP and age groups]

Figure 2 – Cumulative incidence of outcomes between March 2nd, 2020 and June 27th, 2021* per 100'000, stratified by gender/sex, across age groups and quintiles of socio-economic position, Canton of Vaud surveillance data 2020-2021, Switzerland

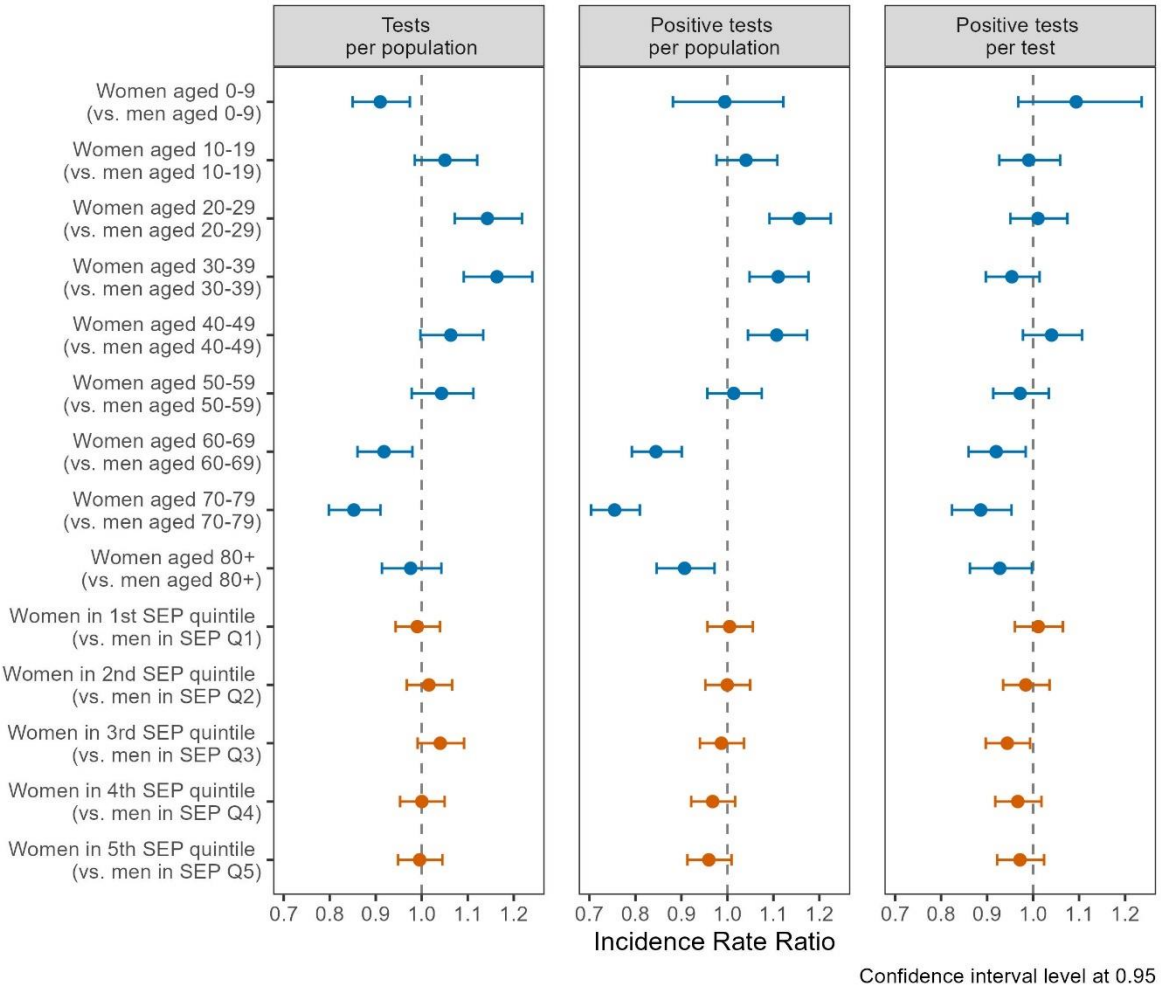


Notes: **Panel A** indicates the cumulative incidences of outcomes stratified by gender/sex across age groups, while **Panel B** displays incidences across quintiles of socioeconomic position (SEP). The SEP indicator was not derived for hospitalization and ICU admissions, as only the ZIP code was available for these outcomes.

For visual clarity, the highest incidence point within each category have been brought to the foreground. *The period considered covered 57 weeks for total tests, and 69 weeks for the other outcomes of interest.

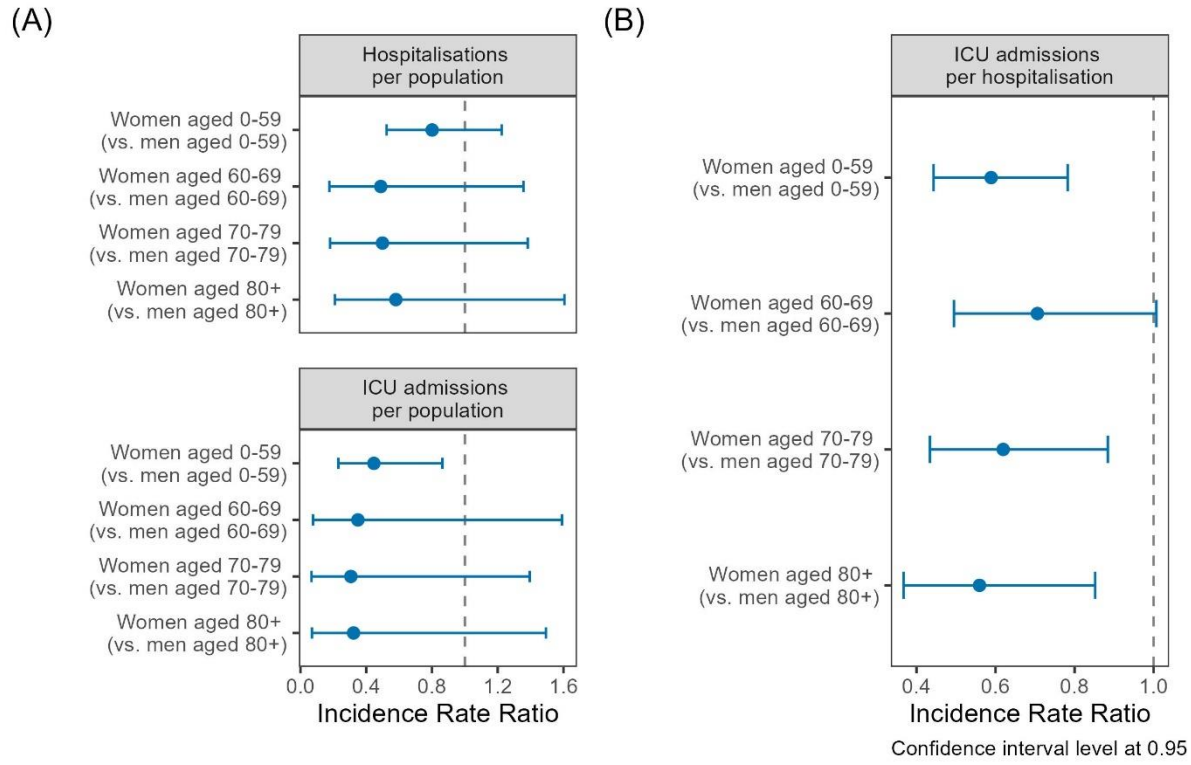
[Fig. 3 – IRR of tests and positive tests]

Figure 3– Incidence rate ratios (IRR) of gender/sex (ref.: men) for number of tests and of positive tests, stratified by age groups (upper part), and quintiles of socio-economic position (SEP, lower part), using general population (left and center panel) and total number of tests (right panel) as denominator, Canton of Vaud surveillance data 2020-2021, Switzerland



[Fig. 4 – IRR of hospitalisations]

Figure 4 – Incidence rate ratios (IRR) of gender/sex (ref.: men) for hospitalization (upper panel) and ICU admission (lower panel) stratified by age groups, using general population as offset (panel A), and ICU admission per hospitalisations (panel B), Canton of Vaud surveillance data 2020-2021, Switzerland



[Fig. 5 – IRR of deaths]

Figure 5 – Incidence rate ratios (IRR) of gender/sex (ref.: men) for death, by age groups (blue coefficients), and quintiles of socio-economic position (SEP, red coefficients), using general population as offset, Canton of Vaud surveillance data 2020-2021, Switzerland