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Estimating DALYs directly Assoc. with COVID-19 in the Rep. of Ireland: The First Full Year

Declan Moran, School of Public Health, University College Cork, Cork, Ireland.

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

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Authors

Declan Moran *[1], Sara Monteiro Pires [2], Grant Wyper [3], Brecht Devleesschauwer [4, 5], Sarah Cuschieri [6], Zubair Kabir [1].

1. School of Public Health, University College Cork, Cork, Ireland.
2. National Food Institute, Technical University of Denmark, Lyngby, Denmark.
3. Place and Wellbeing Directorate, Public Health Scotland, Glasgow, Scotland.
4. Department of Epidemiology and Public Health, Sciensano, Brussels, Belgium.
5. Department of Translational Physiology, Infectiology and Public Health, Ghent University, Merelbeke, Belgium
6. Faculty of Medicine & Surgery, University of Malta, Msida, MSD 2080, Malta.

* Corresponding author: E-Mail: 120111161@umail.ucc.ie

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Introduction

- Wide international disparity relating to the direct impact on population health as a result of COVID-19.
- Burden of Disease (BoD) frameworks facilitate estimation of disease impact to be translated into a single measure, such as the Disability-Adjusted-Life-Year (DALY).
- DALYs achieve this through standardising the effects of morbidity/mortality as a function of time.

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Introduction

- The DALY is one of the most internationally used summary measures of population health and is a key metric in the Global Burden of Disease study (GBD).
- DALYs facilitate comparison of
  - disease impact against other diseases/injuries,
  - localised regions or
  - specified demographic groups.

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COVID-19 in Ireland

- February 29, 2020, first COVID-19 case found in RoI.
- March 12, 2020, the Irish government initiated limited lockdown, further extended to full lockdown by March 27, 2020.
- Ireland continues to fight the COVID-19 pandemic.

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Parameters

- Direct impact of COVID-19 in the Republic of Ireland.
- Duration - March 01, 2020, to February 28, 2021,

- (first full year of the pandemic in Ireland).

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Methods

- Based on Burden-eu/ECDC consensus disease model.
- DALYs were calculated as the sum of Years of Life Lost (YLL) and Years Lived with Disability (YLD).
- DALY = YLL + YLD.

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Methods

- Used only publicly available data.
- Data sourced from the DATA.GOV.IE, which collates data from several national organisations,
  - Central Statistics Office (CSO),
  - Health Protection Surveillance Centre (HPSC),
  - Health Service Executive (HSE),
  - Department of Health (DoH).

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Methods - YLL

- YLL is the product of the number of deaths (M) and the average remaining life expectancy (RLE) at the time of death. (YLL = M x RLE)

- Inputs
  - (M) Published by CSO for events created on the Computerised Infectious Disease Reporting (CIDR) system.
  - (RLE) GBD standard life tables for 2019, by sex.

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Methods - YLD

- YLD, the product of the number of incident cases (N), the average duration (D), and the disability weight (DW). (YLDinc = N x D x DW)

- Inputs
  - (N) DATA.GOV.IE
  - (D) Multiple sources
  - (DW) GBD 2019 study for infectious diseases of the lower respiratory tract.

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Methods - YLD

- Health states, their description, and their disability weights based on GBD 2019 study for infectious diseases of the lower respiratory tract, except for health state *"Critical"*, which was defined by the European Disability Weight study.
- Durations for *"severe"* and *"critical"* provided by Irish hospital data.
- "*PAC*" assumed to be 13.3% of the overall symptomatic incidence with duration of 28 days.

Health state	Assumption/Description	Disability weight (95% uncertainty interval)	Duration
Asymptomatic	Person was infected with COVID-19 but did not present for a Polymerase Chain Reaction (PCR) confirmation test.	Nil	0.00
Moderate	Person had a PCR confirmed COVID-19 diagnoses which was managed in the community and did not require hospitalisation.	0.051 (0.032 – 0.074)	7.79
Severe	Person had a PCR confirmed COVID-19 diagnoses which required hospitalisation but *not* intensive care.	0.133 (0.088 – 0.190)	10.9
Critical	Person had a PCR confirmed COVID-19 diagnoses which required hospitalisation and admission to intensive care (with or without ventilation).	0.655 (0.579 – 0.727)	13.1
Post-Acute Consequences	Person infected with COVID-19 developed chronic sequelae (note persons attributed to the "*post-acute consequences*" health state did not necessarily have a PCR confirmed COVID-19 diagnoses).	0.219 (0.148 – 0.308)	28

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Data Analyses

- Results are scaled by a factor of 1/365.25.
- Uncertainty Intervals derived from input variables upper and lower confidence intervals.
- Uncertainty mainly in relation to transition probability and duration of health state “PAC”.
- A sensitivity analysis assessed a combination of assumptions to maximise and minimise “PAC” health state.

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Results

- 220,273 confirmed cases of COVID-19.
- 4,500 deaths.
- Of total symptomatic cases, 6.5% required hospitalisation, of those hospitalised, 10.8% required treatment in an intensive care unit (ICU).
- Estimate DALYs of 51,532.1 DALYs (50,671.6, 52,294.3)

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Results

- YLL contribute 98.7% towards the DALYs.
- Largest contributing sub-population were Females 65-79 10,665.5 (10,532.3, 10,800.9)
- Largest DALYs per 100,000 persons seen in the Male 80+ population (12,893.3 (12,671.4, 12,902.6)).
- We estimate 11.5 (11.3, 11.6) DALYs per death.

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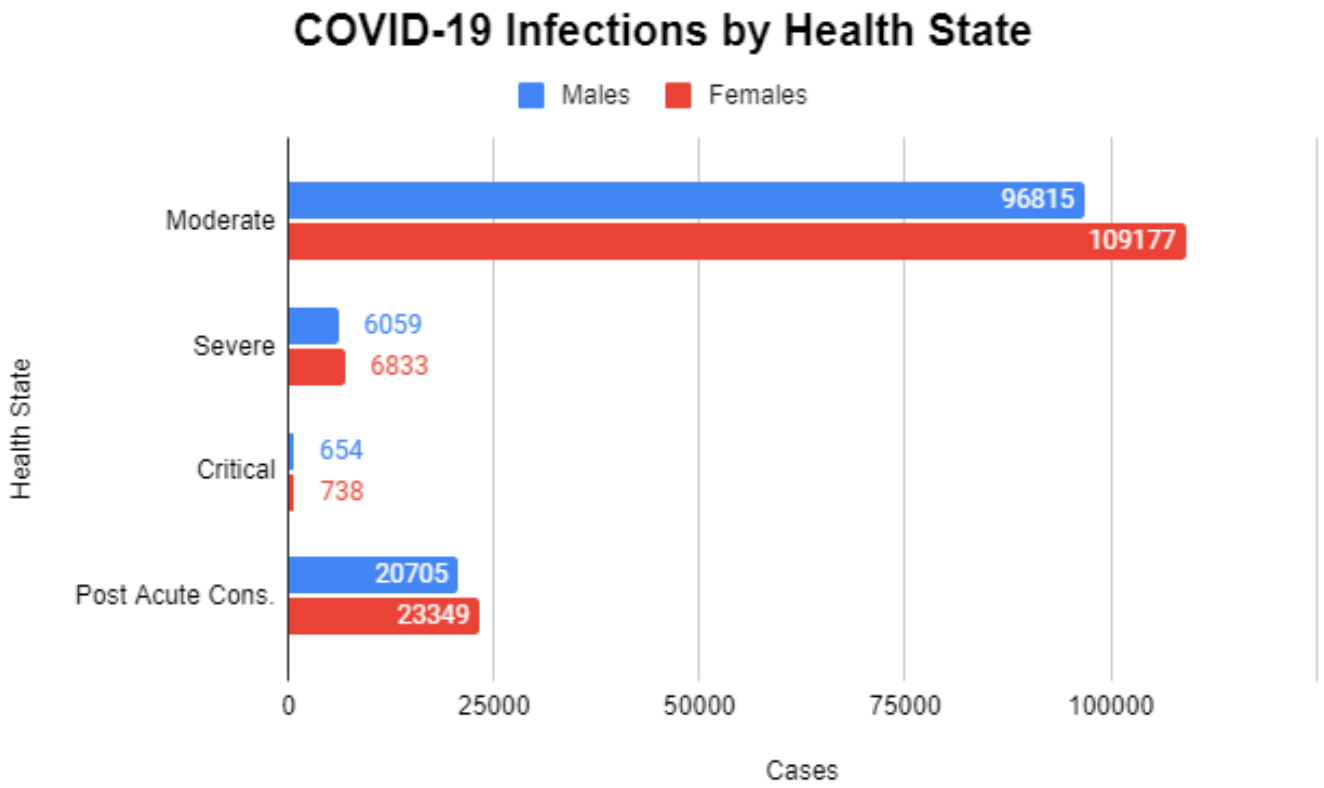
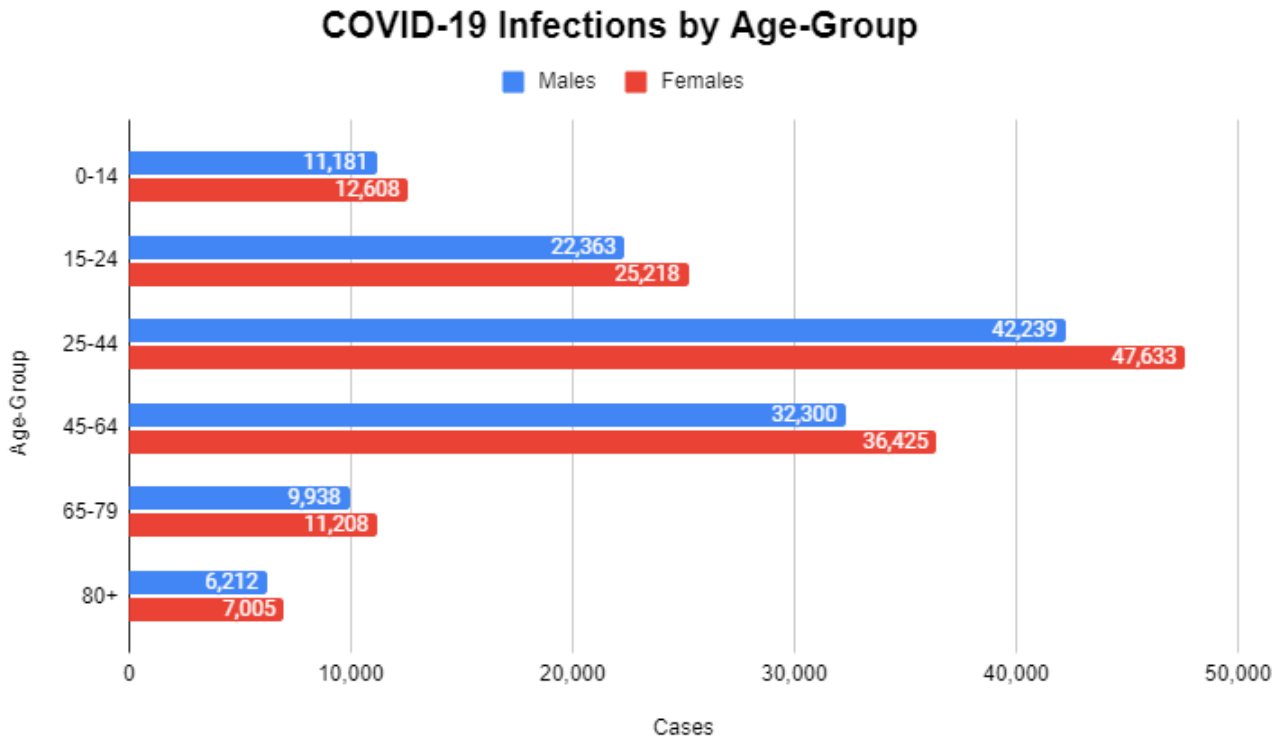
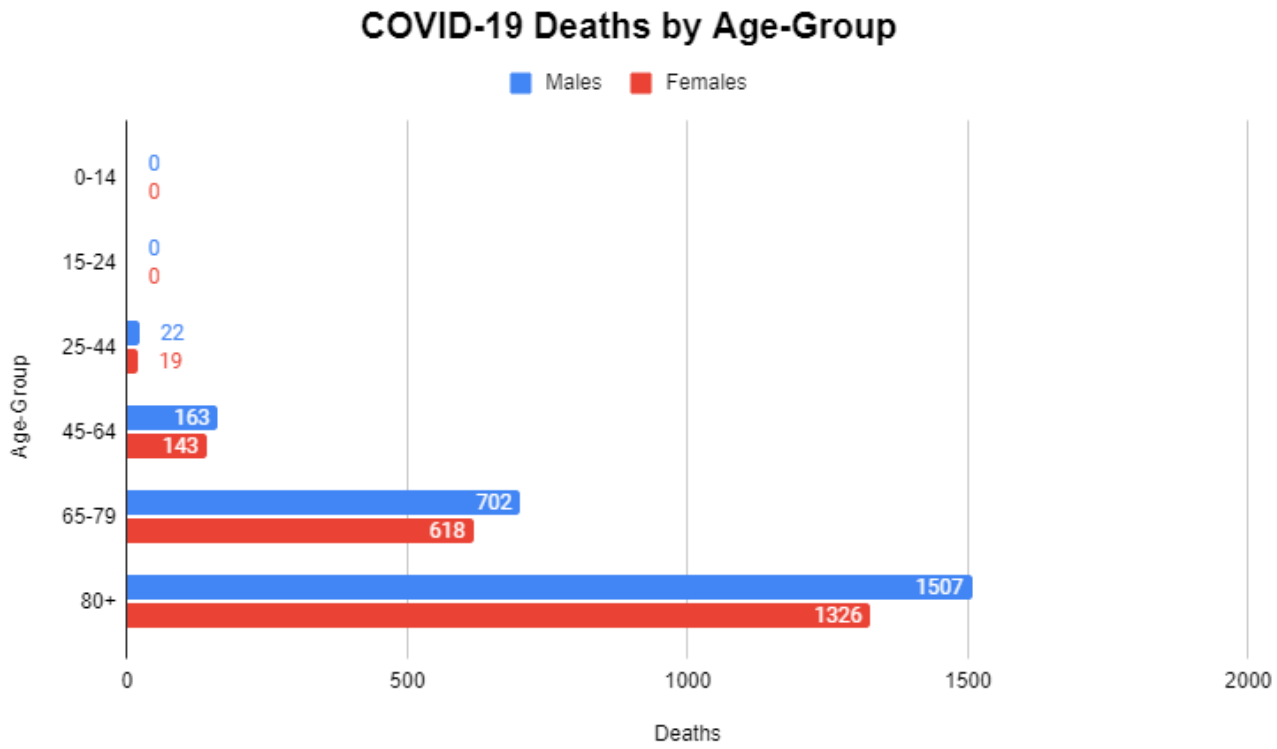
Overall Findings



Overall Findings



Overall Findings



Sensitivity Analyses - Results

Description	YLD	DALY
Health state “PAC” transition probability 5%	444.1 (294.6, 641.3)	51,302 (50,515, 51,986.1)
Health state “PAC” transition probability 25%	999.3 (669.8, 1,422.2)	51,857.2 (50,890.2, 52,767)
Health state “PAC” duration 14 days	549.5 (365.8, 789.4)	51,407.4 (50,586.2, 52,134.2)
Health state “PAC” duration 56 days	1,287.8 (864.8, 1,827.9)	52,145.7 (51,085.2, 53,172.7)
Scenario to minimise impact of YLD - “PAC” transition probability of 6.65%, symptomatic cases only - “PAC” duration of 14 days	424 (282.1, 597.6)	51,281.9 (50,502.5, 51,942.4)
Scenario to maximise impact of YLD - “PAC” transition probability of 26.6%, asymptomatic and symptomatic cases - “PAC” duration of 56 days	8,157.9 (5,508.6, 11,474.5)	59,015.8 (55,728.92, 62,819.3)

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Irish Context

- COVID-19 is likely the 2nd highest cause of death in RoI over our study's duration (ischemic heart disease).
- COVID-19 is also likely to have the 2nd highest YLLs (IHD).
- DALYs are comparable to estimates relating to 'Unintentional Injuries' (54,835.6).
- YLDs are comparable to Non-Hodgkin Lymphoma (682.0) and Idiopathic Developmental Intellectual Disability (642.5).

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Discussion

- Overall, DALYs were marginally higher in males than females.
- DALY contribution significantly increased in populations 65+.
- This biological inequality suggests that the higher age-groups of both male and female are at a higher risk, particularly of mortality from COVID-19.

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Limitations

- Privacy restrictions mean that mortality data with population counts <5 (i.e., males 0- 14) remain unavailable, we estimated a resulting max underestimation of 1,118.0 (95%UI 1,113.1, 1,123.2) DALYs).
- Due to the recency of the COVID-19 pandemic, no attempt was made to account for multimorbidity.

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Limitations

- Comparison of COVID-19 cases with 2019 GBD Study is for contextualisation only. Given the age profile, it is implausible that all COVID-19 deaths are additional (i.e., deaths in the higher age-groups may have occurred irrespectively due to other causes).

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Policy/Research Implications

- Older adults bore an unequal health burden which ultimately resulted in greater DALYs for this population, overwhelming informed by mortality.
- Obvious strategy for DALY reduction would be to focus on mortality reduction, with particular focus on high-risk groups.
- Recommended areas for future research include examining impact of the vaccination rollout, formulation of COVID-19 specific DW's and an extensive BoD study relating to the *indirect* results of the pandemic.

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Acknowledgments/ More Information

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- COVID-19 burden-EU task force.
- University College Cork.

- Currently undergoing peer review with the Int. Journal of Public Health.
- Study available (pre-print) at https://www.medrxiv.org/content/10.1101/2021.12.29.21268120v1.full-text

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