COVID-19. Male/Female vulnerability estimates and related death ratio

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Following the recent coronavirus fatalities in the majority of the world territories it was evident that the male infections and deaths overwhelmed those of women at a significant percentage. The main questions posed as why this difference happen could have various explanations ranging from biological differences to the way of living and socioeconomic factors. That we know is that a difference in life expectancy and healthy life expectancy in favor of females is expected in almost all countries at least the last decades. Cardiovascular diseases play a significant role in male mortality while smoking and drinking habits already in higher percentage in male than female population accused of a difference in mortality.

However, the big differences already existing in mortality data where not explained adequately. In Italy in 2016 female vs male differences provided by the healthy life expectancy estimates are 74.3 to 72.0 years of age for females and males respectively. Accordingly, small health differences appear in other countries not explaining the large differences due to coronavirus.

The main question addressed after the coronavirus spread was on how to do health estimates to account for the new outcomes.

Important is to use the already existing tools along with the new coronavirus data. Clearly the health state estimates are the key tools for an advanced methodology. From this point of view, the Healthy Life Expectancy provided by the World Health Organization under the term HALE is accepted as a standard tool for the health state of a population. As it is provided as years of healthy age it can give an estimate for the age at which the health state should be examined.

The next is to adopt a model providing the health state of a population during the life span. So far a simple decreasing linear model is proposed for the health state of Medfly data by Weitz and Fraser[4] in the Proceedings of the National Academy of Sciences (USA, 2001, 98(26), 15383-15386). An advanced model to account for the human population was proposed by C. Skiadas and C. H. Skiadas in Communications in Statistics Theory and Methods (2010, 39, 444-451). The improvement was done by replacing the linear form for the health state by a concave decreasing Health State Function H(x)[1]. The Mean Health State curve is easily found by fitting a model to mortality data provided from a Life Table[2,3]. Documentation and further analysis appear in a last years' publication in volume 46 (2018) of the Springer Series on Demographic Methods and Population Analysis https://doi.org/10.1007/978-3-319-76002-5 and in a forthcoming book (vol. 50, 2020) in the Springer Series on Demographic Methods and Population Analysis https://www.springer.com/gp/book/9783030446949 .

For the case of Germany, the 2016 Human Mortality Database life tables are used. Females show higher health state level (red curve) than males (blue curve) in all period of the lifespan as is illustrated in figure 1. A vertical dashed line starting from the HALE age for males (70.2 years of age) provided by the World Health Organization (WHO) cuts the health state curves in specific points expressing the health state level. This is at 55% for males and at 72% for females. Note that for people receiving their pension at that age (70.2 years) a difference of 17% health state appear. This difference was 13.2 years at 65 years of age, the usual retirement age level. The HALE age for males at 70.2 years of age was selected for comparisons. The health already lost at this age is 100%-72%=28% for females and 100%-55%=45% for males. The already lost health for males and females at the male HALE age is used as a measure of the further ability of both sexes to resist in a pandemic as Covid-19. The estimated vulnerability fraction is M/F=62/38=1.62. The death fraction for M/F until April 4 in Germany was 63/37=1.71 very close to our estimates.

More estimates and related death fractions appear in figure 2 for several countries[5]. Greece and Italy exceed the theoretical estimates followed by Denmark and China while South Korea, Belgium and Portugal show lower values. In summary the coronavirus death tolls just highlighted the already existing male/female health differences.

Further information, documentation and software downloads at
http://www.smtda.net/demographics2020.html .

References

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[2]Skiadas, C.H. and Skiadas, C. (2018). *Demography and Health Issues: Population Aging, Mortality and Data Analysis*. The Springer Series on Demographic Methods and Population Analysis 46. Springer, Chum, Switzerland. https://doi.org/10.1007/978-3-319-76002-5

[3]Skiadas, C.H. and Skiadas, C. (2020). *Demography and Health Issues: Population Aging, Mortality and Data Analysis*. The Springer Series on Demographic Methods and Population Analysis 50. Springer, Chum, Switzerland. https://www.springer.com/gp/book/9783030446949 (in Press).

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[5]Coronavirus data from COVID-19 sex-disaggregated data tracker at https://globalhealth5050.org/covid19/

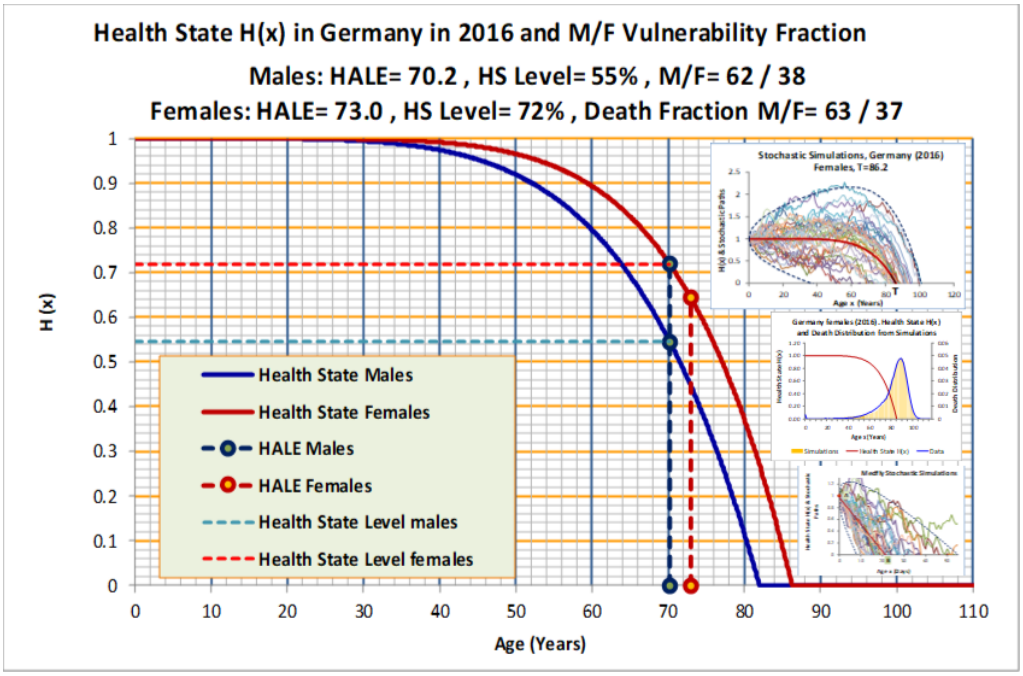

Fig. 1. Health State, Vulnerability and Death Fractions for Males and Females in Germany

Death Data and Vulnerability Estimates for various Countries						
	Deaths (%)		Vulnerability (%)		Ratio (Male/Female)	
Country	Male	Female	Male	Female	Death	Vulnerab
Denmark	61	39	56	44	1.56	1.27
China	64	36	56	44	1.78	1.27
Sweden	58	42	57	43	1.38	1.33
Canada	52	48	57	43	1.08	1.33
Norway	52	48	57	43	1.08	1.33
England and Wales*	61	39	57	43	1.56	1.33
Republic of Ireland	59	41	58	42	1.44	1.38
Switzerland	61	39	58	42	1.56	1.38
Australia	60	40	58	42	1.50	1.38
Italy	67	33	59	41	2.03	1.44
USA	60	40	59	41	1.50	1.44
The Netherlands	61	39	59	41	1.56	1.44
South Korea	52	48	60	40	1.08	1.50
Greece	72	28	61	39	2.57	1.56
Spain	63	37	62	38	1.70	1.63
Belgium	54	46	62	38	1.17	1.63
Germany	59	41	62	38	1.44	1.63
Portugal	54	46	62	38	1.17	1.63
France*	61	39	63	37	1.56	1.70
Coronavirus data from COVID-19 sex-disaggregated data tracker at						
https://globalhealth5050.org/covid19/					*Incomplete data	

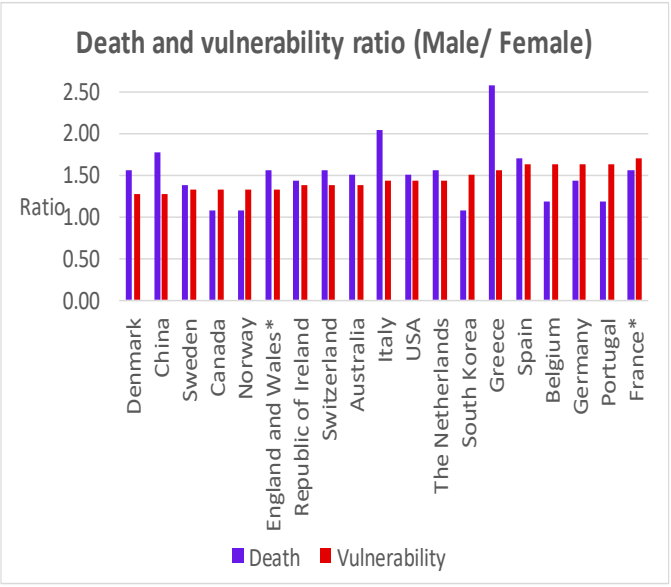

Fig. 2. Death and vulnerability ratio for various Countries