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DOI
10.1111/tesg.12437

Publication date
2020

Document Version
Final published version

Published in
Tijdschrift voor Economische en Sociale Geografie

URBAN-RURAL POLARISATION IN TIMES OF THE CORONA OUTBREAK? THE EARLY DEMOGRAPHIC AND GEOGRAPHIC PATTERNS OF THE SARS-COV-2 EPIDEMIC IN THE NETHERLANDS

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Received: April 2020; accepted May 2020

ABSTRACT

The global health crisis due to the pandemic of the SARS-CoV-2 is associated with processes of urbanisation and globalisation. Globally well-connected areas with high population densities are hence expected to be disproportionately affected by COVID-19. This paper investigates the role of population density within the Netherlands, comparing hospitalisation and mortality related to COVID-19 across municipalities. The paper finds that infections, hospitalisation and mortality related to COVID-19 are not clearly correlated with the population density or urbanity of the municipality, also when controlling for age and public health factors. The paper concludes that while the public debate stresses the elevated risk of infections in cities, due to transgressive behaviour, the evidence in this paper suggests that the geography of the epidemic in the Netherlands is more complex. It speculates that the variation in urbanisation in most of the country might just be too small to expect significant differences.

Key words: COVID-19; SARS-CoV-2; urbanization; spatial polarization; density; epidemiology

INTRODUCTION

The outbreak of the new SARS-CoV-2 virus sparks new public and academic debate about the consequences of urbanisation. Historically, epidemiologists have linked the emergence of new infectious diseases and their proliferation to high densities of people and animals (McNeil 1976; Diamond 1998; Wolfe *et al.* 2007; Munster *et al.* 2018; Wood *et al.* 2017). Proximity and interactions of people are the key drivers of urbanisation processes; urbanity, what is the urban is often defined in terms of density, the absence of distance (Storper & Scott 2016). Urbanisation is increasingly problematised as the increasing densities and interconnections are argued to facilitate the rise and proliferation of infectious diseases (Alirol *et al.* 2013). In work by Connolly *et al.* (2020) it is argued that especially processes of extended urbanisation, that is urbanisation into former non-urban areas, may render societies more vulnerable to the spread of infectious diseases, such as SARS-CoV-2. As Connolly *et al.* (2020, p. 4) say (paraphrasing Wald 2008) 'cities have been known by public health officials as 'promiscuous' social spaces, with people 'literally and figuratively bumping up against each other in smaller spaces and larger numbers than ever before'.

In this light, it is not surprising that the rapid spread of the new highly contagious

Tijdschrift voor Economische en Sociale Geografie – 2020, DOI:10.1111/tesg.12437, Vol. 111, No. 3, pp. 513–529.

SARS-CoV-2 causing a serious and sometimes a lethal infection (WHO 2020) is associated with dense cities and urbanisation. Having its presumed origins in the city of Wuhan, an industrial powerhouse with an agglomeration of 9 million people, and from there spreading globally into highly urbanised areas of Northern Italy, Germany and the Low Countries, the SARS-CoV-2 virus has become associated with some large metropolitan areas of the developed world. The rapid rise in deaths in London, Madrid and New York only catalysed the global image of the SARS-CoV-2 virus as an urban problem (Connolly *et al.* 2020).

Furthermore, the SARS-CoV-2 crisis exposed economic interdependencies and revealed the vulnerability of the just-in-time economic system based on global production chains. It also made clear that globalisation can facilitate the rapid and wide proliferation of the virus across the world through the networks of international mobility of people and goods (Ali & Keil 2006, 2007; Keil & Ali 2006; Wolf 2016). In the current 'Corona-crisis', public and social media speculate that mobilities of goods and people are linked to specific local and regional outbreaks, such as the annual trek of Northern Europeans who go on ski holidays in the Alps and brought back the virus from the sunny slopes of the Italian mountains to their middle class neighbourhoods. In this vein, being discursively linked to urbanisation and globalisation, the outbreak sparks anti-urban sentiment. The Corona crisis plays into an old adagio of the polluted, dangerous and overcrowded city versus the pure and clean countryside. The city is seen as a source of potential infection, for instance evidenced by the expulsion of urban dwellers who seek to pass their home-isolation in second homes (or rentals) in non-urban areas at the coast (Heyblom 2020). This sentiment is also witnessed in the UK where Londoners are not welcome in Cornwall and in France where Parisians are not welcome in rural areas (Onishi & Méheut 2020; Urwin & Calver 2020).

In response to the global outbreak most countries have adopted stringent measures of social distancing (WHO 2020; Wilder-Smith & Freedman 2020). In many countries staying at home is sternly advised and many commercial and social activities are discouraged. While some differences in timing and degree can be observed between countries and within countries, by and large most people are asked to lock down and stay at home as much as possible. Also in the Netherlands as a series of increasingly strict measures have been adopted in response to first contain and later mitigate the spread of the virus. In the absence of a vaccine and without wide spread test-and-trace strategies, social distancing is the key mitigation strategy in the Netherlands (Anderson *et al.* 2020). In several countries authorities have adopted far-reaching measures to enforce compliance with social distancing rules. In Spain and Italy for instance the armed forces were deployed to maintain the new social order. A substantial part of the population in many countries, however, did not need to be forced in line but seemed to act responsibly out of free will and social conformity. In Sweden, government response relies almost entirely on social compliance and individual/collective responsibility. Also the Dutch official response emphasises individual responsibility in what the prime minister referred to as 'an adult democracy with proud adult people'. He stressed that 'what does not work in the Netherlands is a government telling you what to do; this is something you do together' (prime minster Rutte on Rijksoverheid.nl 2020). This approach relying on individual responsibility and solidarity builds on high social trust and confidence in official health authorities (Siegrist & Zingg 2014). The Netherlands has been regarded a high-trust society and social distancing in the early staged seems to have be widely upheld. In fact, as Uitermark (Ham 2020) notes many citizens adopt even stricter rules than official guidelines and, importantly also engage in social control and policing of others.

This paper sets out to confront the evidence of the role of density of the spread of SARS-CoV-2 in the Netherlands and the public discourse on the Corona-crisis. The remainder of this paper will be concerned with two issues: first I will discuss the public debate about the outbreak in the Netherlands, especially in terms of social distancing. Then, I will present an analysis of the demographic and geographical factors that are associated with the spread of the epidemic. I will draw on an content analysis of national newspapers as well as a search of twitter handles related to the SARS-CoV-2

epidemic. For the statistical analysis I use public data of the Dutch National the Institute of Public Health and the Environment (RIVM) and Statistics Netherlands (CBS).

Representations of the outbreak and social distancing – Historically infectious diseases are a source of fear and epidemics have both inspired greater solidarity as well as processes of othering across social and spatial cleavages. The outbreak of the bubonic plague in China in the nineteenth century, spreading to Hong Kong and Bombay around the turn of the century, culminated in a segregation frenzy across the British empire. Colonialists responded to the epidemic by greatly increasing segregation of white populations, isolating them from supposed unclean and infectious native populations (Nightingale 2012). The cholera and tuberculosis epidemics of the nineteenth century in the rapidly urbanising cities of western Europe and the US also sparked new waves of segregation and escape from the unhealthy, infected and infested cities to rural and suburban residences (Jackson 1987). However, these public health crises, which mainly affected cities, also raised awareness that poor hygiene conditions of the poor were also the rich men's and hence a *collective* problem (McNeill 1976). The response to epidemics is therefore both an epidemiological and a sociological challenge, not only revealing patterns of the spread of the pathogen, but also exposing the social and spatial patterns of inequality, social solidarity and trust.

Baehr (2005, 2008) discusses the SARS-CoV-1 (SARS) epidemic in 2003 in Hong Kong and in particular how the response laid bare the what he calls 'debility' of the political order of Hong Kong. Moreover, he argues that the epidemic fostered new forms of solidarity, which are enacted through the emerging 'mask culture' among Hong Kong citizens. He says:

> Mask-wearing became the quickly improvised, if obligatory, social ritual; failing to don one was met with righteous indignation, a clear sign of ritual violation. The mask symbolised a rule of conduct – namely, an obligation to protect the wider community – and an expectation regarding how one was to be treated by others. (…) Mask-wearing activated and reactivated a sense of a common fate; it was a mode of reciprocity under conditions that supremely tested it. Accordingly, mask demeanor was much more than a prophylactic against disease. It showed deference to public emotions and the decision to respect them' (Baehr 2008, p. 150).

Although the current SARS-CoV-2 is more contagious than the more deadly SARS-1-virus for which rigorous isolation of cases had proven an effective measure to contain this virus (Hsieh *et al.* 2005), there are very relevant parallels between the SARS crisis and to the current crisis. Given the higher levels of asymptomatic cases (Treibel *et al.* 2020) and the generally higher levels of R0 (infection number) of SARS-CoV-2, community infection occurs faster and more under the radar: 'anyone' could be infected. Social distancing measures are therefore the centre-stone of all public health responses world-wide if feasible in combination with track and trace strategies such as in South Korea and. In the Dutch context, where test-and-trace strategies were quickly abandoned and mask wearing is not recommended, social distancing is the central pillar of the Dutch official approach to the epidemic (van Dissel 2020a). As this approach is not very strictly enforced, it also renders its success contingent on compliance and collective responsibility, social distancing is not just the key mitigation measure, it is also the social ritual that reveals social solidarity with the 'community of fate'. Staying at home and keeping distance in public spaces are the ways in which Dutch people can show their deference to public emotions. No wonder that (not) complying with the recommendations of officials have become one of the most hotly debated issues in (social) media. In national TV talkshows, the development of the outbreak is a daily returning topic but also many talk show guests and hosts alike express their opinions about how 'the Dutch' behave. In the terminology of Wald (2008) the 'outbreak narrative' is not just about the rising death toll and the tracking of the capacity of ICUs, it is also fraught with social, cultural and spatial meaning. The narratives about SARS-CoV-2/COVID-19 are also strongly about the measures that have been taken, the success or failure of stopping the virus and whether people are doing enough, that is, whether they act responsible and sensible and in the interest of the social body.

Newspapers publish various articles about social distancing behaviour, also wondering what may explain regional differences (Bolle & Wassens 2020). On social media, notably on Twitter, many people post Corona related updates about their own status, which are typically demonstrating 'good' behaviour: staying at home and keeping distance. Similar to what happened when people started adding tractors to their Twitter handle in support of the farmers in their conflict with the Ministry of Agriculture (and RIVM), the home/house symbol as well as twitter handles such as [Name]#staythefuckhome or [Name] stayshome or [Name]#keep1.5 metredistance are public displays of socially desirable behaviour (Figure 1).

A second common theme which is closely related to people positioning themselves as good responsible citizens is the amazement, frustration and anger about particular situations and places where people do not comply. Interestingly, in these debates several themes can be discerned. First there is a general blaming of everyone who does not abide the social distancing rules of the authorities, accusing them of irresponsible and egocentric behaviour. This may be directly punished discursively by pointing out that people who behave irresponsibly should give up the right to be treated in hospital in the scarce ICUs (Figure 2). Oftentimes irresponsible behaviour is also framed as an insult and an affront to health care workers who are working very hard to cope with the epidemic. Similar to what Baehr (2005) described for Hong Kong during the SARS epidemic, health care workers are 'the heroes' of this crisis. Their heroism is celebrated and also used as a moral yard stick for why people should conform to social distancing. Furthermore doctors are also publically visible during this crisis and also speak out in TV shows, newspaper opinion pages and on twitter. A letter from a nurse in an Amsterdam hospital in newspaper *Het Parool* received a lot of (social) media attention (van Megen 2020). The letter, headed 'People, what the heck are we doing?! Please stop bootcamping and yoga-ing in the Vondelpark' has several sections that tie into the broader debate:

> It is the Sodom and Gomorra of the Corona crisis! I'm flabbergasted. Apart from some, the instructions of the authorities are ignored by everybody: bootcamp clubs, yoga lessons in groups of 20 to 30 people, groups of friends are running right next to each other, puffing and panting: I have seen it all.

Although this quote does not talk about who the transgressors are, it is obvious that by yoga and bootcamp groups typically younger

Note: Text reads: "'I want to be open about everything a IC patient experiences…about the anaesthesiologist Coen Feron (28) who works at the ICU and got #Corona himself and ended up on the ICU' Must-read for everyone who already tramples the social distancing rules. *#stayhome*"

Figure 1. *Dutch twitter handle 26 April 2020: 'Elsschot[flags]Keep 1.5 metre distance!'. [Colour figure can be viewed at wileyonlinelibrary.com]*

Note: "Really this is too little. It's time for high fines ánd registering this behaviour. If ICU's were to become overcrowded and triage necessary, these people should be at the bottom of the list, even below the older than 80- year olds?"

Figure 2. *Twitter post 29 March 2020, in response to tweet: Police end parties in Brabant: [Colour figure can be viewed at wileyonlinelibrary.com]*

generations are implied. It clearly alludes to what Wald (2008, p. 14) referred to when she talked about 'promiscuous urban spaces'. This Corona-related social distancing debate seems characterised by a central cleavage between age/generations. This has several dimensions. First of all, the virus disproportionally affects elderly and seems to spare younger generations. This highlights the issue of solidarity between the generations. Moreover, younger people are portrayed as being less able to show solidarity and constrain themselves. In a commentary in the same newspaper the day after, Paul van Lange, professor social psychology at the Free University, witnessed how the 1.5 metre rule is predominantly ignored by young adolescents. "Psychologically this is no surprise' he says. 'Young people have a stronger urge to socially belong than older people and their ability to self-regulate is not fully developed" (Raatgever 2020.) Despite the fact that many young people are living in relatively small dwellings, typically with family –in the case of teenagers-, and often with other roommates – in the case of students – they are criticised for being too much outside and blamed for not maintaining social distance and acting selfishly (Figure 3). Although obviously there are also different voices in the debate, intergenerational differences in terms of complying with the rules, are a central theme in the public discourse.

Another issue that is closely connected to this frame of intergenerational conflict, is the degree to which people in different places are conforming to social distancing. Noord-Brabant as the hot bed of the epidemic is often used as a spatial reference. Already early in the outbreak the critical situation in Noord-Brabant was juxtaposed with naivety and carelessness in other parts of the country. For instance, MP Gert-Jan Segers used spatial dichotomies expressing his frustration about the carelessness in other parts of the country: 'This week ICU doctors in Brabant told us that they had been crying, watching pictures on social media of totally irresponsible people in the Randstad. In Brabant people are dying of Corona and above the rivers too many people act like they don't know anything yet' (De Telegraaf 2020).

These rather stark remarks about irresponsible behaviour of people in the Randstad (the conurbation of major cities) are echoed in multiple tweets about lack of social solidarity and arrogance of inhabitants of the bigger cities (Figures 4 and 5). Of course these comments are not representative for the whole public debate, but they do attest to the tendency to fit newly emerging social issues, of which the Corona crisis is a vivid example, into existing dichotomies (Boterman 2020; Tzaninis *et al.* 2018). At the same time, the Corona crisis generates a lot of 'emotional energy' (Collins 2004) in which people share a sense of purpose, fate, attention and mood. The experience of a sharing a common fate, being in it together also fosters social solidarity. It is from this positive emotion, I would argue, that transgressions

Figure 3. *'Did you see the images from the shopping streets? In a few weeks the #secondwave #corona starts. Disgusting generation 20 years and 30 years olds, fuck the elderly/vulnerable'. [Colour figure can be viewed at wileyonlinelibrary.com]*

Figure 4. *tweet 25 March 2020 in response to Despite warnings it was too busy at the open air market in the Hague. 'It is time we say goodbye to the Randstad. The world cannot stand so much rudeness. Fence it in with barbed wire and let's see what remains after a 100 years'. [Colour figure can be viewed at wileyonlinelibrary.com]*

Figure 5. *'In Amsterdam people don't care, so they couldnt care less what is going on in the country, here they should have mainatined order, I sustect they don't dare because of ethnic profiling'. [Colour figure can be viewed at wileyonlinelibrary.com]*

that jeopardise this solidarity are experienced as provocative and hence publically scolded. As the nurse from the Parool letter concluded: 'I can appreciate a bit of civil disobedience, it's Amsterdam's forte, but this [behaviour] is not innocent'.

The negative sentiment, illustrated by millennials picnicking in small groups in urban park's may not be about the fear of being infected but rather may be about the experience of lack of solidarity with the rest. By associating these transgressions with specific places such as urban parks, irresponsibility is spatialised and become associated with the city, Amsterdam in particular (Boterman 2018). It fits into broader narratives of the city where anything goes, its population defies authority and the status quo does not exist (Nijman 1999). This is both a critique of a hedonistic urban generation and of the cosmopolitan cities themselves, Amsterdam first, that turn away from the rest of the country. The Corona crisis, which is combatted by the authorities with the slogan 'only together we can beat Corona', lays bare some of the fundamental intergenerational and spatial cleavages in Dutch society.

GEOGRAPHY AND DEMOGRAPHY OF THE SARS-COV-2 EPIDEMIC

In daily reports, the RIVM has documented the spread of the virus in the Netherlands (RIVM 2020a, 2020b, 2020c). The maps shown in those reports reveal the eminent role of geography in epidemiology. While municipalities in the provinces of Noord-Brabant and Limburg have high incidences of SARS-CoV-2 confirmed cases, by mid-April 2020, the Northern provinces still had some areas without any reported cases. The most densely populated Randstad provinces of Utrecht and North- and South-Holland, inhabited by about 8 million people, generally do not stand out. These patterns of the epidemic seem to have been fairly stable in the period March/April 2020. The only significant change appears to be the relatively fast spread of SARS-CoV-2 in municipalities in the so-called Bible Belt, where a large share of the population belongs to different orthodox Protestant communities.

As in New York, Lombardy and Madrid, the epidemic in the Netherlands started relatively concentrated in specific regions. In a country measuring about 300 km from North to South, with a very intensively used road and railroad infrastructure, the regional differences are striking. Brabant and Limburg have about a third of all cases and only 20 per cent of all inhabitants. While population densities in these provinces are substantial (520 inhabitants/km2) they are less densely populated than the Randstad provinces North and South Holland and Utrecht. Also, the epicentre of the epidemic in Noord-Brabant and Limburg is not in the most urban areas but rather in the urbanised countryside of Eastern parts of Brabant and the northern parts of Limburg. The specific concentration of SARS-CoV-2 cases in Noord-Brabant and Limburg has been ascribed to the carnival celebrations in February. Indeed the much lower infection rate in Western – non-Catholic – parts of Noord-Brabant support this hypothesis. Although some other carnival celebrating, Catholic parts of the country do not witness over-representation of SARS-CoV-2, it seems that Brabant and Limburg indeed present special cases within the Netherlands. In contrast to the Catholic provinces, the Northern provinces Friesland, Drenthe and Groningen report substantially lower levels of infections. The local health authorities (GGDs) adopted a much more wide testing regime, which according to chief epidemiologist of the academic hospital of Groningen, Alex Friedrich, has made a significant contribution in mitigating the epidemic in the North (Friedrich

et al. 2020). The Northern provinces, however, are also much less densely populated (between 187–251 inhabitants/km2). Except for Groningen and Leeuwarden no urban areas larger than 100,000 people are situated in these provinces. It may therefore be interesting and warranted to be sensitive to the regional variation when doing some analyses trying to explain some municipal variation.

The expanding knowledge of the demographics of the new virus reveals that of the hospitalisation and fatalities of COVID-19 patients –as we know at this moment – the vast majority is of higher age (RIVM 2020a, 2020b, 2020c; WHO 2020). Of the officially reported COVID-19 cases in the Netherlands 45 per cent is older than 65; of hospitalised patients 61 per cent and even 94 per cent of all COVID-19 related deaths are people older than 65. Especially people over 80 years old account for the lion's share of all reported fatalities and this figure is likely even a strong underestimation given the large numbers of deaths in elderly homes that are likely caused by COVID-19. New data on 'over-mortality' suggest that the official deaths are an underestimation by about 80 per cent, which is disproportionally contributing to mortality among older ages (CBS 2020).

Younger people, to the contrary, appear to be only somewhat less infected but are much less likely to be hospitalised and die from the disease (Jones *et al.* 2020; Slot *et al.* 2020). Of all reported fatalities less than 1 per cent is younger than 40 and they represent about 5 per cent of hospitalisations (RIVM 2020a, 2020b, 2020c; van Dissel 2020a, 2020b). Younger and middle age people, due to their more frequent contacts with other people, are likely to be among the key transmitters of the virus. Currently there is debate about the role of children in this epidemic. Official reporting to the Dutch parliament (van Dissel 2020a) and recent evidence (Zhang *et al.* 2020) concludes children play a small role as infectors, but other evidence suggest that the viral load in children is similar to adults (Jones *et al.* 2020).

DATA AND METHODS

The analyses of the next section draw on data from the RIVM as published daily since the outbreak of SARS-CoV-2. The epidemiological reports contain data at the municipal level in the Netherlands about the number of cases, the hospitalisation and the reported deaths related to COVID-19. I use the data as published on 16 April 2020 and 29 April 2020. These data are complemented with data at the level of municipalities from Dutch Statistics (CBS 2020) about age, income (media standardised personal income), monthly church attendance, and three health variables about the average use of medicine in the municipality. The included types of medicine are based on the reported severity and co-morbidity of COVID-19 (RIVM 2020a, 2020b, 2020c; Simonnet *et al.* 2020). Diabetes medicine, cardiac medicine; and anti-hypertensives are included in the models. To assess the correlation with density and urbanity the share of the urban population of municipalities (people that live in high densities, >1500 people/km2) is included. To also include the variation in population density, thereby controlling for share of the population that lives in highly urban areas, the residuals of the (ordinary least squares) regression of urban population share with population density are included. The residuals have negative values if the population density is lower than what could be expected based on the share of the population that lives in highly urban areas; if they are higher, it indicates that the population density of the municipality is higher than expected.

Finally I divided the country into four parts: the Northern provinces that have a different testing regime; Noord-Brabant/Limburg, where the epidemic started and spread rapidly; the Randstad provinces of Utrecht, North- and South-Holland, that are expected to have fast increase; and the other provinces that are expected to occupy an intermediate position.

The analyses are organised in four models with different dependent variables: (i) The number of cases/100,000; (ii) hospitalisation/100,000; (iii) reported deaths/100,000 on 29 April 2020; and (iv) the change in the number of hospitalisations between 16 and 29 April. The models used are Poisson regressions that estimate the predicted increase in the incident rate (IRR) compared to the mean value. To facilitate intuitive interpretation I included graphs that show the correlation of urbanity on the metrics on the epidemic in Dutch municipalities.

RESULTS

First some of the central relations of this study are introduced by showing the scatter plots is that between population density and the incidence, the hospitalisation and Corona-confirmed fatalities in Dutch municipalities, split out for the four parts of the country.

As Figures 6, 7 and 8 reveal, no clear immediate correlation exists between density, and confirmed cases, hospitalisation rate, and mortality. The plots do reveal the significant differences between the four defined parts of the country: the higher infection rate in Noord-Brabant and Limburg and the lower levels in the Northern provinces. Nonetheless, the correlation between density and COVID-19 metrics within these areas is not clear. Table 1 shows the correlation coefficients for the different parts of the country as well as the whole of the Netherlands, of which none is significant.

Figure 9 shows the correlation between the change in the number of hospitalisations and the log of the population density. In terms of recent changes in infection rates also no evident correlations surface, although for the Randstad provinces a positive correlation is close to significant.

It is evident that the factors explaining different levels of incidence, hospitalisation and mortality are more complex than outright population density. To make a preliminary attempt to cast light upon some of the complexity of these different factors in the next sections the regression models are presented. The first model estimates only the geographic factors; the second introduces age group demographics; the third and final model adds social and health variables to the model.

Models 1 and 2: geographical and demographic factors – As Table 2 reveals, the differences between the parts of the country are very substantial indeed. The Carnival provinces of Noord-Brabant and Limburg still have much higher rates of reported cases, hospitalisation and deaths related to COVID-19 than other parts of the country. Interestingly the Northern provinces and the Randstad provinces have lower incidences than the

Figure 6. *Cumulative number of cases of SARS-CoV-2 per 100,000 inhabitants on the 29th of April 2020, by logarithm of population density. [Colour figure can be viewed at wileyonlinelibrary.com]*

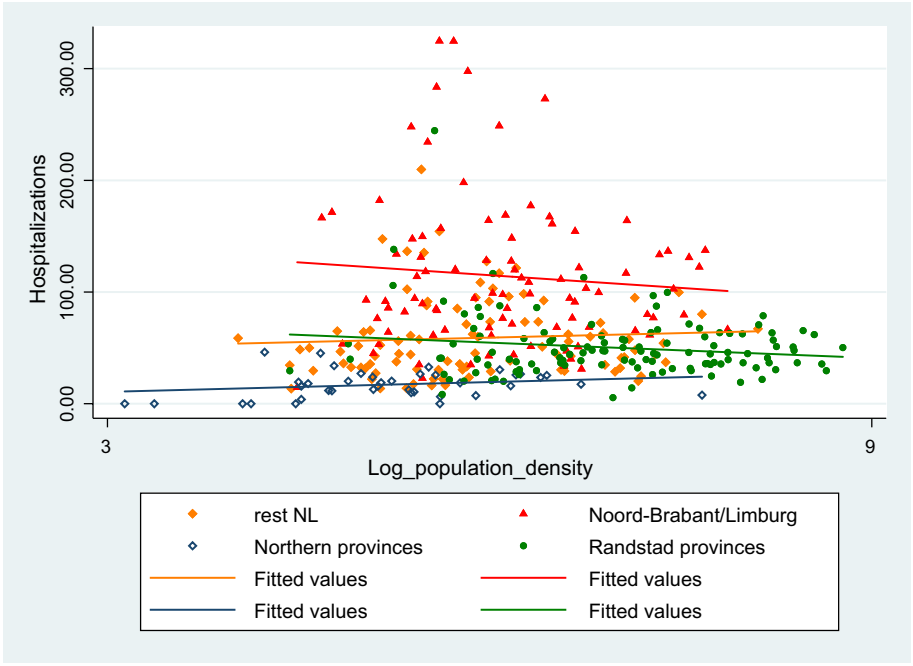

Figure 7. *Cumulative hospitalizations per 100,000 inhabitants on the 29th of April 2020, by logarithm of population density. [Colour figure can be viewed at wileyonlinelibrary.com]*

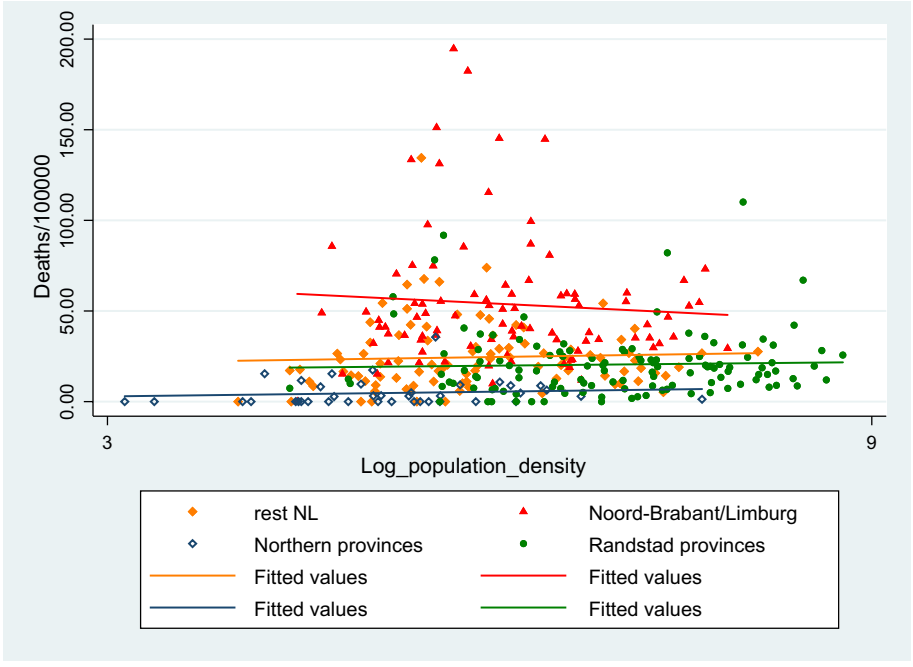

Figure 8. *Cumulative deaths per 100,000 inhabitants on 29th of April 2020, by of population density. [Colour figure can be viewed at wileyonlinelibrary.com]*

Table 1. *Correlations (PW) between Logarithm of population density and metrics of the SARS-Cov-2/COVID-19 epidemic in Dutch municipalities, by region.*

Correlation coefficient with Log population density (sig)

	Cases/100,000	Hospitalization/ 100,000	Deaths/100,000	Change in hospitalization/1000
Other provinces	−0.07 (0.50)	0.06 (0.54)	0.05 (0.69)	−0.03 (0.74)
Noord-Brabant/Limburg	−0.12 (0.27)	−0.09 (0.41)	−0.07 (0.49)	0.07 (0.52)
Northern provinces	0.19 (0.25)	0.22 (0.17)	0.11 (0.50)	0.18 (0.28)
Randstad provinces	0.05 (0.54)	−0.15 (0.10)	0.03 (0.70)	0.13 (0.14)
Netherlands as a whole	0.01 (0.89)	−0.02 (0.71)	0.01 (0.91)	0.03 (0.57)

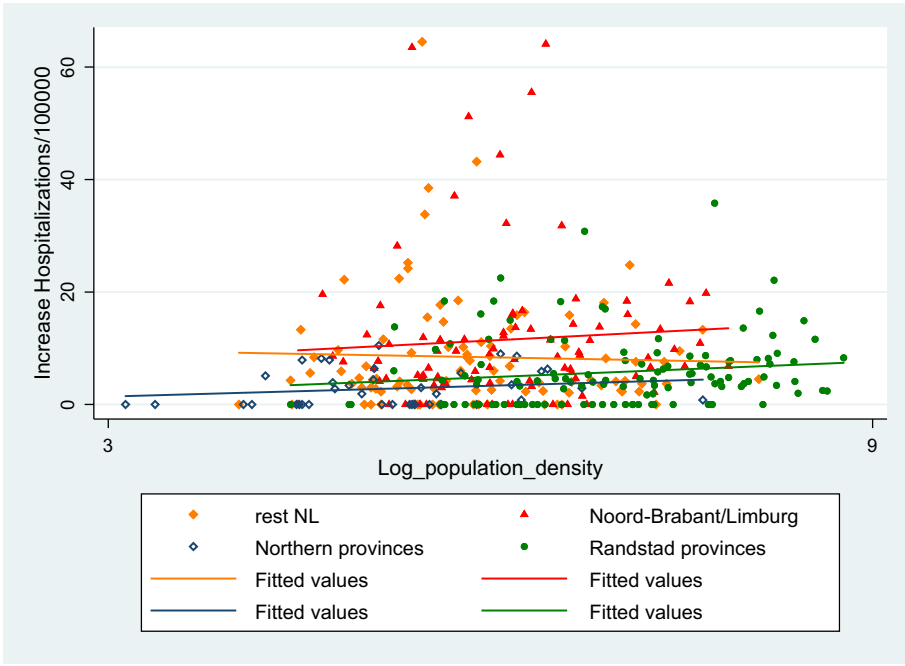

Figure 9. *Increase in number of hospitalizations between 16th and 29th of April 2020, by logarithm of population density [Colour figure can be viewed at wileyonlinelibrary.com]*

other provinces. Level of urbanity has a small negative effect on infection rates and hospital admissions. For population density, corrected for urbanity, a small positive effect is observed for hospitalisations. This probably means that in municipalities with lower levels of urbanity but relative high densities, such as the rather urbanised countryside of Brabant but also parts of the Randstad may have slightly more serious infections.

As model 2 introduces age categories the model improves a bit (+3% variance explained). Interestingly, only relatively numerous youth seems to be associated with infection rates and also mortality related to COVID-19. Surprisingly, the relatively high shares of elderly does not significantly death rates. The effect of region and density remain similar to model 1.

Model 3: Social and public health factors – The third model introduces a number of social and health variables. Church attendance emerges as a risk factor. Not only

Table 2. *Estimates of metrics of the SARS-Cov-2/COVID-19 epidemic in Dutch municipalities (Poisson regressions).*

	Model 1						Model 2						Model 3					
	Cases/100,000		Hospitalization/ 100,000		Deaths/ 100,000		Cases/ 100,000		Hospitalization/ 100,000		Deaths/ 100,000		Cases/ 100,000		Hospitalisation/ 100,000		Deaths/ 100,000	
Dependent variable	IRR	sig	IRR	sig	IRR	sig	IRR	sig	IRR	sig	IRR	sig	IRR	sig	IRR	sig	IRR	Sig
% Population in urban areas	**0.998**	0.05	**0.997**	0.01	0.99	0.55	**0.998**	0.05	**0.997**	0.01	0.99	0.55	0.998	0.22	0.996	0.06	0.999	0.90
Population density difference	1.080	0.06	**1.010**	0.05	1.072	0.28	1.080	0.06	**1.010**	0.05	1.072	0.28	0.996	0.94	1.040	0.52	0.993	0.92
(ref = other provinces)																		
Limburg/Brabant	**1.400**	0.00	**1.920**	0.00	**2.18**	0.00	**1.400**	0.00	**1.920**	0.00	**2.18**	0.00	**1.470**	0.00	**1.870**	0.00	**2.210**	0.00
Northern provinces	**0.296**	0.00	**0.301**	0.00	**0.201**	0.00	**0.296**	0.00	**0.301**	0.00	**0.201**	0.00	**0.386**	0.00	**0.410**	0.00	**0.263**	0.00
Randstad provinces	**0.832**	0.01	0.904	0.28	0.844	0.16	**0.832**	0.01	0.904	0.28	0.844	0.16	0.840	0.06	0.899	0.37	0.765	0.08
(ref = 25-65 years old)																		
youth							**1.030**	0.04	1.020	0.165	**1.060**	0.02	1.010	0.56	1.020	0.18	**1.080**	0.01
% 65-80							0.971	0.17	0.985	0.515	0.990	0.78	0.967	0.12	0.985	0.56	0.990	0.79
% 80 plus							**1.074**	0.02	0.994	0.875	1.090	0.15	1.055	0.10	0.985	0.74	**1.110**	0.04
Median standardized income													1.020	0.30	0.996	0.83	1.000	0.81
Regular church attendance													**1.010**	0.04	1.000	0.44	0.998	0.76
Anti-hypertension medicine use													**1.750**	0.05	1.860	0.11	1.570	0.29
Cardiac medicine use													**1.310**	0.00	**1.410**	0.00	**1.400**	0.01
Diabetes medicine													0.934	0.30	0.870	0.08	0.871	0.24
const	**248.6**	**0.00**	**62.1**	0.00	**24.9**	0.00	**109.6**	0.00	**44.7**	0.00	3.2	0.176	**64.8**	0.00	**28.9**	0.00	1.10	0.84
R2	*0.37*		*0.39*		*0.32*		*0.398*		*0.40*		*0.35*		*0.42*		*0.41*		*0.35*	

Table 3. *Estimates of change in number of hospitalisations due to COVID-19 between 16-2-2020 and 29-4-2020, in Dutch municipalities (Poisson regressions).*

	Model 4: change hospitalization/100,000							
	A		B		C		D	
	IRR	sig	IRR	sig	IRR	sig	IRR	sig
% Population in urban areas	1.00	0.69	1.00	0.86	1.00	0.85	0.99	0.11
Population density difference	1.21	0.03	1.19	0.06	1.05	0.64	1.06	0.58
Limburg/Brabant (ref = other provinces)	1.32	1.08	1.45	0.07	1.25	0.25	1.04	0.89
Northern provinces	0.37	0.00	0.40	0.00	0.48	0.01	0.44	0.02
Randstad provinces	0.63	0.01	0.65	0.01	0.63	0.02	0.46	0.01
Limburg/Brabant#Population in urban areas						1.01	0.08	
North#Population in urban areas							1.01	0.50
Randstad#Population in urban areas							1.01	0.04
youth (ref = 25-65 years old)			1.02	0.89	1.00	0.94	1.00	0.93
% 65-80			1.00	0.92	1.00	0.84	1.00	0.88
% 80 plus			0.95	0.44	0.97	0.71	0.95	0.58
Income					1.04	0.30	1.03	0.40
Regular church attendance					1.00	0.22	1.00	0.38
Anti-hypertension medicine use					2.27	0.16	2.04	0.23
Cardiaca medicine use					1.56	0.03	1.59	0.03
Diabetese medicine					1.08	0.62	1.03	0.86
constant	8.40	0.00	4.99	0.19	0.38	0.65	0.73	0.89
R^2	0.09		0.10		0.11		0.12	

social distancing is difficult in church but also the co-presence of different generations has effects of the spread of the SARS-CoV-2 virus (Hartley *et al.* 2020). In terms of health factors, a high share of the hospitalised patients is suffering from overweight and also hypertension and cardiovascular illness have been reported as factors causing a severe manifestation of COVID-19. The model therefore includes the prevalence of standardised medicine use in the population at the municipal level.

Table 2 reveals that the model improved once more. Church attendance indeed correlates positively with number of cases, but not with more severe incidences. Income does not seem to have any effect. Perhaps this is mediated by the medicine variables which are quite strongly correlated with income. Both anti-hypertensives and cardiac medicine use are positively associated with the number of cases in a municipality. Interestingly, the density and urbanity variables are no longer significant. Regional differences are also slightly reduced: the Northern provinces are still much less affected and Noord-Brabant and Limburg are much more. The Randstad provinces do not differ anymore from the reference category provinces.

Model 4: increase in hospitalisations – The final model estimates the increase in the number of hospitalisations per capita. The model covers the two last weeks of April, which hence relate to infections that happened in the approximately two weeks prior. This, retrospective seems to have been just past the peak of the infection curve in the Netherlands, which was in the third week of March.

Table 3 shows that in the first model (4A) while population in urban areas does not correlate, relative density is associated with faster infection spread. Interestingly, the epidemic still spreads faster in the original hot bed provinces, and goes slower in the Randstad provinces and even more so in the North. When age is introduced (4B) density and urbanity are no longer significant and Brabant and Limburg are no longer witnessing a faster development than the reference provinces. Randstad and Northern provinces

still see slower development. When including also health factors (4C) the geographical factors demonstrate the same patterns of model 4B. Only cardiac medicine use is positively associated with the increase in the number of hospitalisations. Finally, including interaction effects of population density with the specific regions (4D) reveals that for the Randstad provinces the effect of population in urban areas is stronger than for the reference category (other provinces). The effect of other variables did not change. To illustrate the combined effect of region and urbanity, Figure 10 shows the predicted probability for the increase of the number of hospitalisations. As this figure demonstrates, the effect seems to vary for the different regions. However, most of those differences are not significant as evidenced by the overlapping confidence intervals. The slope for the Randstad and for the other provinces however differ significantly, going up slightly for the Randstad. This may thus point to a differentiated role of density and urbanity in proliferation across regions.

DISCUSSION

Urbanisation and globalising networks of people and goods are processes that have historically been associated with the emergence and proliferation of infectious diseases. The most recent epidemics of SARS and the aviary and swine flu evidently revealed the vulnerabilities of global cities and of a globalised world economy (Ali & Keil 2006; Alirol *et al.* 2011). The current COVID-19 crisis caused by SARS-CoV-2 has again been understood as the product of globalisation and urbanisation. Moreover, as COVID-19 (initially?) disproportionally affected global cities like New York, Madrid and London, the current pandemic is also framed in public discourse as an urban problem. This paper analysed the patterns of the SARS-CoV-2 epidemic in the Netherlands and confronted this with the narratives in the public debate about the outbreak.

This paper found for the Dutch context little evidence that the geography of the SARS-CoV-2 epidemic is related to population

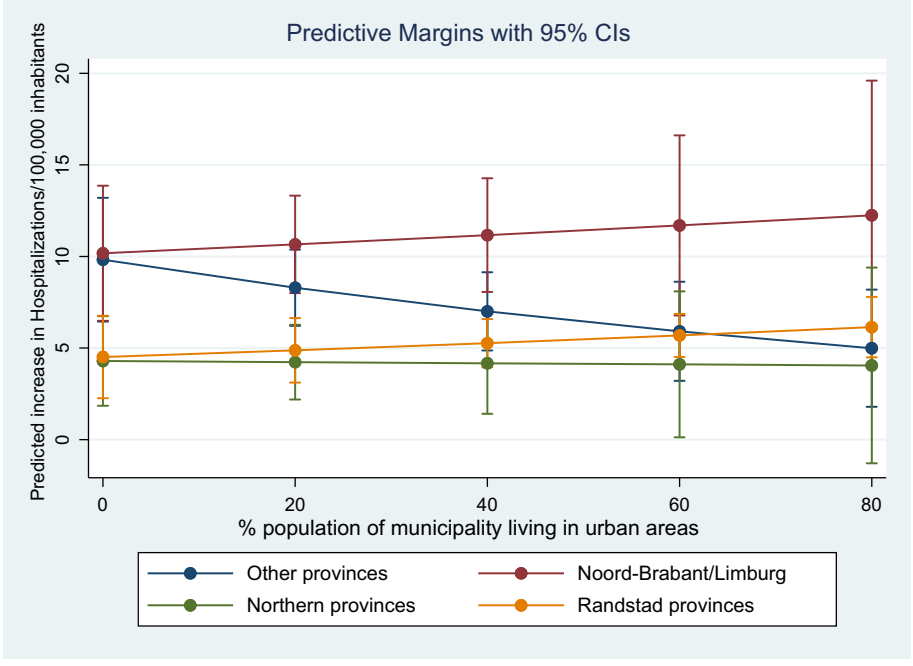

Figure 10. *Predicted increase in the number of Hospitalizations/100,000 16-29th of April, by share urban population and parts of the country [Colour figure can be viewed at wileyonlinelibrary.com]*

density. Although concentrations of infections exist: Noord-Brabant and Limburg; and some regions, the Northern provinces, are notably spared, the analysis presented in this paper, did not find convincing evidence that urbanity and population density are the key factors that can explain the patterns and the increase of the SARS-CoV-2 epidemic within the Netherlands. In fact, the Randstad conurbation, which is one of the most populous urban areas of Europe, has lower levels of SARS-CoV-2 related metrics than most other parts of the country. The larger cities of the Netherlands are therefore not particularly plagued by SARS-CoV-2 compared to more rural parts of the country.

Also, the population composition is not straightforwardly correlated with the different manifestations of the epidemic. The analyses suggested that the share of young people may be a predictor of higher incidence and mortality. However, the most obvious metric one would assume: higher numbers of elderly in the municipality, does not seem to be clearly associated with severe cases and even mortality due to COVID-19. Although the presented analsyes are of course both based on preliminary data and limited in sophistication, any robust and clear correlation would have emerged by now. At least within the Dutch context, which is generally highly urbanised and densely populated, little geographical variation points to the role of density.

The rather polarised debate about social distancing, which as a strategy is indeed apparently contributing significantly to the mitigation of the epidemic (RIVM 2020a), should therefore not be necessarily be explained by the facts of this epidemic. If population density is a key issue and social distancing is poorly upheld among (young) urban populations, the big cities in the Netherlands should have clearly emerged as hotbeds of SARS-CoV-2. This, at least for now (10 May 2020), does not seem to be the case. It seems more likely that narratives about social distancing and density are interlinked with exiting social and spatial cleavages that are played out along different social issues. The 'outbreak narrative', as Wald (2008) calls it, is fraught with socio cultural meaning, fitting into existing and spatial polarisation between urban areas and the rest of the country (Boterman 2020). As this paper illustrated with examples from the (social) media debate, social distancing and staying home are the social rituals of this COVID-19 crisis. Referring to the social ritual of wearing a mask during the SARS epidemic in Hong Kong (Baehr 2005, 2008), I argue that complying with the rules and also publically showing the willingness to do so (i.e. through selfies, social media status posts) is an act and display of solidarity. Correspondingly, not complying with the rules by not keeping one's distance or making unnecessary trips, is publically shamed because it represents a selfish act that jeopardises the community; it represents a transgression that shakes the order of the new normal. This order also has clear spatial dimensions in which cities, and Amsterdam in particular, are framed as displaying less solidarity. This fits into broader narratives of the city where anything goes, and its population defies authority (Nijman 1999).

So, why do these transgressions – if they are indeed more common in urban areas – do not translate into higher incidences of SARS-CoV-2 in the urban populations? Perhaps a faster urban proliferation will emerge later in the course of the pandemic, but for now we might speculate about why the cities in the Netherlands are not standing out. First of all, as we have seen in Northern Italy, Belgium or North-Rhine Westphalia, the epidemic emerged in highly urbanised *regions*. The whole of the Netherlands, maybe excluding the Northern provinces, is highly urbanised and has high population densities. The differences between municipalities within the urbanised provinces of the Netherlands are perhaps less relevant than the fact that the whole country could be considered an urban region. This would then explain the exception of the North, which in addition to having a different mitigation strategy including more widespread testing-and-tracing, is also significantly less urbanised.

A second, additional hypothesis, is related to the extended urbanisation thesis as discussed in the recent paper of Connolly and colleagues (2020). The less urban parts of the Netherlands which are nonetheless strongly affected by the virus, notably Noord-Brabant, are territories of extended urbanisation. The Dutch countryside has relatively high population densities and moreover very intensive agro-industries. Noord-Brabant is one of the biggest pork, and

live animals (pigs, goats) producing regions of Europe and also has a substantial fur industry. The q-fever outbreak (2007–2009), an occupational zoonosis caused by a bacterium, had its epicentre in Noord-Brabant and is directly related to the high density of animals in close proximity to population centres (Schimmer et al 2014). The argo-industries in the Dutch countryside, producing animals, meat, and dairy for the world market are therefore as much part of globalisation and urbanisation as the larger cities. In other words, if urbanisation and globalisation, understood as high concentrations of people and as an extended process of global-local interconnections, are key factors explaining the spread of infectious diseases such as SARS-CoV-2, perhaps the lack of a clear pattern within the Netherlands is exactly what one expects.

REFERENCES

Ali, S.H. & R. Keil (2006), Global Cities and the Spread of Infectious Disease: The Case of Severe Acute Respiratory Syndrome (SARS) in Toronto, Canada. *Urban Studies* 43, pp. 491–509.

Ali, S.H. & R. Keil (2007), Contagious Cities. *Geography Compass* 1, pp. 1207–1226.

Alirol, E., L. Getaz, B. Stoll, F. Chappuis & L. Loutan (2011), Urbanisation and Infectious Diseases in a Globalised World. *The Lancet* 11, pp. 131–41.

Anderson, R.M., H. Heesterbeek, D. Klinkenberg & T.D. Hollingsworth (2020), How Will Country-based Mitigation Measures Influence the Course of the COVID-19 Epidemic? *The Lancet* 395, pp. 931–934.

Baehr, P. (2008), City under Siege: Authoritarian Toleration, Mask Culture, and the SARS Crisis in Hong Kong. *In*: S.H. Ali & R. Keil, eds., *Networked Disease: Emerging Infections in the Global City*, pp. 138–151. Chichester: Wiley Blackwell.

Baehr, P. (2005), Social Extremity, Communities of Fate, and the Sociology of SARS. *European Journal of Sociology/Archives Européennes de Sociologie* 46, pp. 179–211.

Bolle, J.& R. Wassens (2020), Nederland beweegt Weer en Verrommelt. *NRC Handelsblad*, Available at <https://www.nrc.nl/nieuws/2020/05/01/nederlanders-zijn-weer-vaker-op-pad-maar-meer-te-voet-dan-met-de-auto-a3998543>. Accessed on 2 May 2020.

Boterman, W. R. (2020), Carrying class and gender: Cargo bikes as symbolic markers of egalitarian gender roles of urban middle classes in Dutch inner cities. *Social & Cultural Geography* 21, pp. 245–264.

CBS (2020), Regionale Kerncijfers 2018. Available at <opendata.cbs.nl>. Accessed on 22 April 2020.

Collins, R. (2004), Rituals of Solidarity and Security in the Wake of Terrorist Attack. *Sociological Theory* 22, pp. 53–87.

Connolly, C., R. Keil & S.H. Ali (2020), Extended Urbanisation and the Spatialities of Infectious Disease: Demographic Change, Infrastructure and Governance. *Urban Studies*, Online first, DOI:https://doi.org/10.1177/0042098020910873.

De Telegraaf (2020), Ook Politiek Bezorgd over Volle Parken: Blijf Alsjeblieft Thuis als het Kan. 22 March 2020. Available at <https://www.telegraaf.nl/nieuws/175585509/ook-politiek-bezorgd-over-volle-parken-blijfalsjeblieft-thuis-als-het-kan>. Accessed on 29 April 2020.

Diamond, J.M. (1998), *Guns, Germs and Steel: A Short History of Everybody for the Last 13,000 years*. New York: Random House.

Friedrich, A., L. Kroes & C. Vandenbroucke-Geauls (2020), Meer Testen Geeft Inzicht in Epidemie. *NRC Handelsblad*, 28 April 2020. Available at <https://www.nrc.nl/nieuws/2020/04/28/meer-testen-geeft-inzicht-in-epidemie-a3998048>. Accessed on 30 April 2020.

Ham, M. (2020), Interview met Justus Uitermark Corona is een Les in Wederzijdse Afhankelijkheid. *Sociale Vraagstukken*, 8 April 2020. Available at <https://www.socialevraagstukken.nl/interview/socioloog-en-geograaf-justus-uitermark-corona-is-een-les-in-wederzijdse-afhankelijkheid/>. Accessed on 22 April 2020.

Hartley, D.M., H.S. Reisinger & E.N. Perencevich (2020), When Infection Prevention Enters the Temple: Intergenerational Social Distancing and COVID-19. *Infection Control & Hospital Epidemiology*, pp. 1–3. DOI: 10.1017/ice.2020.100

Heyblom, O. (2020), Amsterdams gezin weggestuurd uit tweede woning in Zeeland. *Het Parool*, 29 March 2020. Available at <https://www.parool.nl/amsterdam/amsterdams-gezin-weggestuurd-uit-tweede-woning-in-zeeland-dat-mag-gewoon-niet~b45430e9/>. Accessed on 31 May 2020.

Hsieh, Y., C. King, C. Chen, M. Ho, J. Lee & F. Liu (2005), Quarantine for Severe Acute Respiratory Syndrome (SARS). *Taiwan. Emerging Infectious Disease* 11, pp. 278–282.

Jackson, K.T. (1987), *Crabgrass Frontier: The Suburbanisation of the United States*. Oxford: Oxford University Press.

Jones, T.C., B. Muehlemann, T. Veith, M. Zuchowski, J. Hofmann, A. Stein, A. Edelmanmn, V. Max Corman & C. Drosten (2020), *An Analysis of SARS-CoV-2 Viral Load by Patient Age*. Berlin: Institut für Virologie.

Keil, R. & S.H. Ali (2006), The Avian Flu: Some Lessons Learned from the 2003 SARS Outbreak in Toronto. *Area* 38, pp. 107–109.

McNeill, W.H. (1976), *Plagues and Peoples*. Garden City, NY: Anchor Press.

Munster, V.J., D.G. Bausch & E. de Wit (2018), Outbreaks in a Rapidly Changing Central Africa – Lessons from Ebola. *New England Journal of Medicine* 379, pp. 1198–1201.

Nightingale, C.H. (2012), *Segregation: A Global History of Divided Cities*. Chicago, IL: University of Chicago Press.

Nijman, J. (1999), Cultural Globalisation and the Identity of Place: The Reconstruction of Amsterdam. *Ecumene* 6, pp. 146–64.

Onishi, N. & C. Méheut (2020), Rich Europeans Flee Virus for 2nd Homes, Spreading Fear and Fury. *New York Times*, 29 March 2020. Available at <https://www.nytimes.com/2020/03/29/world/europe/rich-coronavirus-second-homes.html>. Accessed on 22 April 2020.

Raatgever, S.. (2020), *Waarom wil de ernst van de coronasituatie maar niet doordringen?*, Het Parool, 22 March 2020, Available at <https://www.parool.nl/nederland/waarom-wil-de-ernst-van-decoronasituatie-maar-niet-doordringen~bba39cd8/>. Accessed on 30 April 2020 .

RIVM (2020a), website. Available at <https://www.rivm.nl/en/novel-coronavirus-covid-19/current-information-about-novel-coronavirus-covid-19>. Accessed on 16 April 2020.

RIVM (2020b), website. Available at <https://www.rivm.nl/documenten/epidemiologische-situatie-covid-19-in-nederland-16-april-2020>. Accessed on 19 April 2020.

RIVM (2020c), website. Available at <https://www.rivm.nl/documenten/epidemiologische-situatie-covid-19-in-nederland-29-april-2020>. Accessed on 30 April 2020.

Rijksoverheid (2020), *website*. Available at <https://www.rijksoverheid.nl/documenten/mediateksten/2020/03/31/persconferentie-minister-president-rutte-en-minister-de-jonge-over-verlenging-coronamaatregelen> Accessed on 15 April 2020.

Schimmer, B., N. Schotten, E. van Engelen, J.L.A. Hautvast, P.M. Schneeberger & Y.T.H.P. van Duijnhovem (2014), Coxiella Burnetii Seroprevalence and Risk for Humans on Dairy Cattle Farms, the Netherlands, 2010–2011. *Emerging Infectious Diseases* 20, pp. 417–426.

Slot, D., B.M. Hogema, C.B.E.M. Reusken, J.H. Reimerink, M. Molier, J.H.M. Karregat, J. Ijlst, V.M.J. Novotný, R.A.W. van Lier & H. Zaaijer (2020), Herd Immunity is Not a Realistic Exit Strategy during a COVID-19 Outbreak. *Preprint on Research Square*, 1–15. https://doi.org/10.21203/rs.3.rs-25862/v1.

Siegrist, M. & A. Zingg (2014), The Role of Public Trust during Pandemics. *European Psychologist* 19, pp. 23–32.

Simonnet, A., M. Chetboun, J. Poissy, V. Raverdy, J. Noulette & A. Duhamel (2020), High Prevalence of Obesity in Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) Requiring Invasive Mechanical Ventilation. *Obesity*, Online First. https://doi.org/10.1002/oby.22831.

Storper, M. & A.J. Scott (2016), Current Debates in Urban Theory: A Critical Assessment. *Urban studies* 53, pp. 1114–1136.

Treibel, T., C. Manisty, M. Burton, A. McNight, J. Augusto, X. Couto-Parada, T. Cutino-Moguel, M. Noursadeghi & J.C. Moon (2020), COVID-19: PCR Screening of Asymptomatic Health-care Workers at London Hospital. *The Lancet*, 395 1604–1610. https://doi.org/10.1016/S0140-6736(20)31100-4.

Tzaninis, Y., Boterman, Willem R. & Pratsinakis, M. (2018), Right-wing populism and xenophobia: beyond the urban/suburban dichotomy in the Netherlands. *Urban Studies Working Papers University of Amsterdam*, (30), pp. 1–22.

Urwin, R. & T. Calver (2020), Coronavirus fears of second home hordes bringing covid-19 to holiday havens may have come true, *The Times*, 05-04-2020. Available at <https://www.thetimes.co.uk/article/coronavirus-fears-of-second-home-hordes-bringing-covid-19-to-holiday-havens-may-have-come-true-k868w2fzb>. Accessed on 31 May 2020.

van Dissel, J. (2020a), Technische Briefing Tweede Kamer. 16–04-2020. Available at <file:///C:/Users/wboterm1/Downloads/PowerPoint_presentatie_dhr._Van_Dissel_-_RIVM_-_Update_coronavirus.pdf>. Accessed on 22 April 2020.

van Dissel, J. (2020b), Technische Briefing Tweede Kamer. 22–04-2020. Available at <https://www.tweedekamer.nl/sites/default/files/atoms/files

/20200422_technische_briefing_jaap_van_dissel_rivm_22_april.pdf>. Accessed on 31 May 2020.

van Megen, F. (2020), Mensen, waar Zijn We Mee Bezig? Ga Alsjeblieft niet Bootcampen en Yogaën in het Vondelpark. *Het Parool*, 21 March 2020. Available at <https://www.parool.nl/columns-opinie/mensen-waar-zijn-we-mee-bezig-ga-alsjeblieft-niet-bootcampen-en-yogaen-in-het-vondelpark~b6c1ba4a/>. Accessed on 31 May 2020.

Wald, P. (2008), *Contagious: Cultures, Carriers, and the Outbreak Narrative*. Durham, NC: Duke University Press.

WHO (2020), Coronavirus Disease 2019 (COVID-19) Situation Report-44. Available at <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200304-sitrep-44-covid-19.pdf?sfvrsn=783b4c9d_2>. Accessed on 22 April 2020.

Wilder-Smith, A. & D.O. Freedman (2020), Isolation, Quarantine, Social Distancing and Community Containment: Pivotal Role for Old-style Public Health Measures in the Novel Coronavirus (2019-nCoV) Outbreak. *Journal of Travel Medicine* 27, pp. 1–4.

Wolf, M. (2016), Rethinking Urban Epidemiology: Natures, Networks and Materialities. *International Journal of Urban and Regional Research* 40, pp. 958–982.

Wolfe, N.D., C.P. Dunavan & J. Diamond (2007), Origins of Major Human Infectious Diseases. *Nature* 447, pp. 279–283.

Wood, C.L., A. Mcinturff, H.S. Young, D. Kim & K.D. Lafferty (2017), Human Infectious Disease Burdens Decrease with Urbanisation but not with Biodiversity. *Philosophical Transactions of the Royal Society B: Biological Sciences* 372, pp. 1–14.

Zhang, J.J., X. Dong, Y.Y. Cao, Y.D. Yuon, Y.B. Yang, Y.Q. Yan & Y.D. Gao (2020), Clinical Characteristics of 140 Patients Infected with SARS-CoV-2 in Wuhan, China. *Allergy*, Online First, https://doi.org/10.1111/all.14238.