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Urbanicity mental costs valuation
A review and urban-societal planning consideration

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Abstract

Living in cities has numerous comparative advantages than living in the countryside or in small villages and towns, most notably better access to education, services and jobs. However, it is also associated with a roughly twofold increase in some mental disorders rate incidence compared with living in rural areas. Economic assessments reported a forecasted loss of more than 19 trillion dollars in global GDP between 2011 and 2030 and of around 7 trillion for the year 2030 alone when measured by the human capital method. If we exclude self-selection processes and make the hypothesis to be able to level down the mental illness rate incidence in urban areas to these of the rural by better urban-societal planning, around € 1.2 trillion could be saved yearly worldwide. Even a reduction of only 20% in urban mental illness rate would save around 260 billion dollars yearly.

Keywords: Urban Quality of Life; Urbanization; Psychology of Urban Life; Economic Valuations; Neurourbanism.

1. Introduction: urbanicity, mental health, life satisfaction, and residential preferences

Within the top twenty reasons of global burden of disease, there are five mental illness – depression (2^{nd}), anxiety (7^{th}), schizophrenia (11^{th}), dysthymia (16^{th}), and bipolar disorder (17^{th})

– which in 2013, even if probably underestimated by more than 1/3, resulted to be the leading causes of years lived with disability (Vigo *et al*. 2016). Globally, in 2015, non-communicable diseases were 60% of total disability-adjusted life-years, of which 12% corresponded to mental disorders, neurological disorders, substance use disorders, and self-harm (Vigo *et al*. 2019). Mental health disorders are also the primary cause of Disability-Adjusted Life Years worldwide (Bloom et al. 2011).

Decades of empirical research shows an association between mental health and urbanicity, especially for the individuals genetically more inclined and those who lived in cities during their early life.

Links, often proven to be causal by longitudinal and dose-response analysis, between urbanicity and mental illness have been greatly reported such as in these 85 studies: Coid, Zhang, Li 2020; Evans et al. 2020; Vargas, Conley, Mittal 2020; Sampson et al 2020; Lecic-Tosevski 2019; Reed et al. 2018; Evans et al. 2018; Castillejos et al. 2018; Kirkbride et al. 2006, 2018; Cooper et al. 2017; Besteher et al. 2017; Gruebner et al. 2017; Krzywicka and Byrka 2017; Vassos et al. 2016; Newbury et al. 2016; Brockmeyer and D'Angiulli 2016; Adli et al. 2016; Freeman et al. 2015, Wilker et al. 2015; Peterson et al. 2015; Haddad et al. 2015; Vaessen et al. 2015; Steinheuser et al. 2014; Haluza et al. 2014; Krabbendam et al. 2014; Strelt et al. 2014; Calderón-Garcidueñas et al. 2013, 2014; Heinz et al. 2013; Bedrosian and Nelson 2013; Stevens et al. 2013; Tandon 2012; Lederbogen et al. 2011; Fonken et al. 2011; Larson 2011; Galea et al. 2011; McClung, 2007, 2011; Meyer-Lindenberg 2010; Park et al. 2010; Bowler et al. 2010; Kelly et al. 2010; Mortensen et al. 2010; Levesque et al. 2010; Gwang-Won et al. 2010; Tae-Hoon et al. 2010; Peen et al. 2007, 2010; van Os et al. 2001, 2004, 2010; Kennedy et al. 2009; Bentall et al. 2008; March et al. 2008; Joens-Matre et al. 2008; Fuller et al. 2007; Graziano and Cooke 2006; Maas et al. 2006; Pedersen and Mortensen 2001a,b, 2006a,b; Weich et al. 2006; Krabbendam and van Os 2005; Tsunetsugu and Miyazaki 2005; Wang 2004; Sundquist et al. 2004; van Os 2004; McGrath et al. 2004; Harrison et al. 2003; Caspi et al. 2003; Frumkin et al. 2001; Allardyce et al. 2001; Haukka et al. 2001; Torrey et al. 2001; Eaton et al. 2000; Schelin et al. 2000; Marcelis, Takei, van Os 1999; Mortensen et al. 1999; Marcelis et al. 1998; Thornicroft et al. 1993; Lewis et al. 1992; Cohen 1982; Eaton 1974; Christmas 1973; Faris and Dunham 1939; White 1903.

Paykel *et al*. (2000), analysing data from almost ten thousand individuals (Household Survey of the National Morbidity Survey of Great Britain) via a logistic regression, reported "a considerable British urban–rural differences in mental health, which may largely be attributable to more adverse urban social environments".

According to Vassos *et al*. 2016, the rate of incidence of nine types of psychiatric disorders is in average *1.6 times higher* in the capital city than in the rural areas, with 'schizophrenia and related disorders' even almost double (1.83), while the review of McGrath *et al*. 2004 of 68 studies found a schizophrenia incidence rate *2 times higher* in urban areas than in mixed rural/urban areas; a rate that rises up to a *2.75 times greater* risk of schizophrenia when one has lived 15 years of her early life in a capital city rather than a rural area (Pedersen and Mortensen 2001a). Peen et al. (2007) reported an odds-ratio for mental disorders in very highly urbanized areas of *1.6* related to non-urbanized (1.8 when unadjusted by control variables). An approximatively *twofold increase* in psychosis risk associated with urbanicity is also confirmed in the following empirical studies: Pedersen, Mortensen 2006a,b; Kirkbride et

al. 2006; Sundquist, Frank, Sundquist 2004; van Os, Pedersen, Mortensen 2004; Harrison et al. 2003; Haukka, Suvisaari, Lonnqvist 2001; Torrey et al. 2001; Allardyce et al. 2001; Pedersen and Mortensen 2001a,b; van Os et al. 2001; Schelin et al. 2000; Marcelis, Takei, van Os 1999; Mortensen et al. 1999; Marcelis et al. 1998. An increase as high as *fourfold* was found in Eaton, Mortensen, Frydenberg 2000. A meta-analysis review summarised that urban dwellers have a *1.4 times greater* risk of mood disorders than non-urban (Penn et al. 2010).

Due to the type of the analysis conducted, the causality (rather than a reverse causation) of the nature of this link, emphasising that urbanicity has an etiological effect on mental health, has been underlined, among many, by March et al. 2008; van Os, Kennis and Rutter 2010; Lederbogen et al 2011.

If we shift our attention to people's preferences toward places to live their lives, "many surveys about quality of life in cities invariably suggest that it is in smaller cities that the highest quality of life is achieved" (Batty 2018, p. 95). Similarly, to European surveys, 44% of Americans voted small towns/rural environments as the best kind of places to live and only roughly one in five (20%) voted cities (Knox and Pinch 2006). Another questionnaire (D'Acci 2020) reported that only 32% of respondents prefers to live in a city rather than (*ceteris paribus*) in a natural environment (36%), in a town/village (24%), in a suburb (6%), while 2% of them were indifferent.

In line with these stated residential preferences, happiness seems to decrease when urbanicity levels increase (Sander 2011; Lawless and Lucas 2011), and studies about self-declared life satisfaction, psychological well-being in rich countries systematically show lower levels of life satisfaction in urban areas compared to the rural or less urban areas (Viganò et al. 2019; Helliwell et al. 2018; Okulicz-Kozaryn and Mazelis 2018; Okulicz-Kozaryn 2017; Gilbert et al. 2016; Sørensen 2014; Berry and Okulicz-Kozaryn 2013, 2009; Fassio et al. 2013; Easterlin *et al*. 2011; Lawless and Lucas 2010;).

This discrepancy between rural and urban environments' influence on mental health, life satisfaction and happiness suggest that by re-organizing our socioeconomic urban daily life and the physical urban-regional structure itself, there would be a potential margin of reduction in the urban mental illness rates and an increase of life satisfaction and daily mood of urban dwellers.

To convince governments, urban and regional planners, stakeholders and the ordinary population about the relevance of the issue, an economic translation of the costs that psychological effects that cities have to us, might help to make the topic more tangible.

2. Economic valuations of mental costs

Mental disorder costs go far beyond the *direct* costs (diagnostic and treatment); their economic costs assessment for the society as a whole should monetarily translate also the following *indirect* factors: increased chance of leaving school early, lower likelihood of achieving good and full-time employment, reduced quality of life for the individual and her loved ones. The monetary quantification of indirect costs on health usually follows the human capital method which measures the personal direct costs plus the amount of discounted earnings from lost productivity due to several reasons such as those listed above (Doran and Kinchin 2017; Gustavsson *et al*. 2011).

Early commencement mental disorders result to be statistically significantly associated with the interruption of secondary education (Leach and Butterworth 2012), which in turn means less likelihood to be employed in higher skilled professions (Schofield *et al*. 2011a).
As expected, psychiatric disorders between the ages of 18 and 25, after controlling for confounding variables, was statistically significantly (p-value < 0.05) negatively linked with workforce participation, income and economic living standards at age 30, and, more generally, cumulative episodes of psychiatric disorders negatively affect life outcomes (Gibb *et al.* 2010).
However, a bi-directional causality might appear between mental health and labour force participations as once workforce participation is being affected, a dangerous positive feedback loop could start: you get mentally ill then you work less, and the more excluded from work the more mentally ill you might be (Laplagne *et al*. 2007). This unemployment rate within the mentally ill population has being quantified to be as high as four times more than the healthy population, and when they work they are more inclined both to *presenteeism* (work with low productivity) and *absenteeism* (more leave for illness) (Schofield *et al*. 2011). This psychological distress cost related to lower productivity has been estimated in 2010 to be A$ 5.9 billion (equivalent to roughly A$ 7.5 billion in 2019) per annum in Australia (Hilton *et al*. 2010), and the individuals' loss due to depression has been assessed as a 73% lower income than their full-time counterparts, while those deciding to retire early because of their mental health issues have 78% lower incomes, which at a national aggregate level means US$ 407 million in transfer payments, $ 278 million in lost income taxation revenue, and almost $ 2 billion in GDB, just in 2009 (Schofield *et al*. 2011).
Reports for Canada (Smetanin *et al*. 2011) assessed that in 30 years (2011-2041) the cumulative costs related to mental illness could be around US$ 3 trillion (based on US$ 2019) – even if underestimated for the lack of some types of cost and of mental illness – and in 2010-2011 Australia spent A$ 6.9 billion (7.7% of all government health outlay) in mental health services by governments and health insurers[1]. Studies also estimate that personal family costs and lost productivity for businesses and other non-government organisation costs, equal, or even surpass, the total government expenditures (Degney *et al*. 2012; Hilton *et al*. 2008; Jacobs *et al*. 2010).
The 2018 OECD report estimates as more than 4% of GDP (around € 600 billion) the costs due to mental illness across Europe (OECD/EU 2018), while Gustavsson *et al*. (2011) estimated it to be around € 800 billion for the 2010, including Norway, Iceland and Switzerland to the 28 European countries.
A team of members from the World Economic Forum and the Harvard School of Public Health (Bloom *et al*. 2011) used different methods (although non comparable among each other) to estimate mental disorders costs: (1) direct and indirect costs by *human capital approach* (the standard cost-of-illness method), (2) impact on *economic growth* (macroeconomic simulation), and (3) *value of statistical life* (willingness to pay).
Each method has a different approach: personal *versus* social, private *versus* public, yearly costs *versus* multiple years' cumulative costs.

[1] Department of Health and Ageing. National mental health report 2013, Canberra: Commonwealth of Australia, 2013.

The human capital approach (1), as we anticipated earlier, considers personal costs such as medical costs, transportation, care, income losses (related also to education loss due to illness), and sometimes it can also add non-personal costs such as public health education campaigns and research.
The economic growth method (2), also called the value of lost output, considers how the investigated diseases diminish labour, capital and any other factors involved in the GDP formation at the country level, focusing on the illness related mortality rates impact on GDP.
The value of statistical life method (3) is based on the people's willingness to pay (a kind of trade off) to lessen the risk of disability or death connected with the analysed illness, therefore by attaching an economic value to health/life itself it goes beyond the practical impact on GDP alone. The quantification is done either by observed trade-offs (e.g. in the labour market the wage premium a worker is willing to receive to take a job with a high injury-death risk, or the extra amount of money an individual spends for healthier food) and hypothetical trade-offs (surveys asking people how much they would pay to elude a risk or how much they would ask to take that risk).
By method 1) the team (Bloom *et al*. 2011) estimated a world cost for mental illness of US$ 2.5 trillion for the year 2010 alone, and US$ 6 trillion for the year 2030 alone, two-thirds of which for indirect costs.
By method 2) they estimated a world cumulative GDP loss of US$ 16.3 trillion (USA dollars 2010) due to mental health alone over 20 years (2011-2030).
By method 3) they estimated a world output loss of US$ 8.5 trillion in 2010, and US$ 16.1 trillion in 2030.
Converted into US$ for the year 2019, they resulted approximatively US$ 19.2 trillion of GDP loss during the 20 years between 2011 and 2030; US$ 7.1 trillion of human capital loss for the year 2030 alone; and US$ 18.9 trillion the willingness to pay for the year 2030 alone.
All these estimates, even if already showing impressively high economic loss translations, are very likely underestimated (Whiteford *et al*. 2016).

3. Urban-societal planning influence

It seems clear from decades of a reasonable amount of mutually confirming independent research that urban life has unfavourable (often hidden) effects on our psyche, especially for those genetically susceptible and for those exposed to urban contexts during their juvenile years when the brain is still developing, whose causality has been proven by longitudinal and dose-response studies.
Most people may not be aware about this psychological damage as it might be that the harm does not reach a sufficient entity to become visible, and that would remain below a certain level implying a manifested invisibility. Yet, individuals might still suffer some kind of psychological uncomfortable feeling even without being able to define it, or, if so, to establish the direct link with their urban life.
If it is indeed true that it is not 'only' a small percentage of genetically susceptible urban dwellers targeted by statistically significantly higher psychosis risks, but a larger urban population, although with consistent variability in magnitude, we need to include this type of mental costs within any cost-benefit alike analysis.

Territorial and urban planners cannot ignore the negative consequences that cities and territories have on our psychological well-being and mental health when poorly planned, designed and managed (e.g. endless cementification, lack of daily natural contact, congestion, lack of sky view, crowding, visually and socially boring dormitory areas extended for hectares, …). The same is valid for actions enabling us to change our socio-economic systems toward a more liveable scenario: just to cite an example, teleservices and teleworking (i.e. working remotely from home or wherever), a practice more and more in use[2] and even becoming law (since July 2015, first case in Europe and probably in the world) in the Netherlands if the worker wishes, would dramatically improve quality of life, free time, work efficiency and productivity, and enormously reduce congestion, daily car use, pollution, car park-street space, carbon emissions, and so on. Similar effects would be induced by flexible personalized working times (following personal biological circadian rhythms – essential for health and productivity – and private life schedules) and reduction of national daily working hours from, e.g. from 8 hours to 6 hours: equivalent or probably even higher productivity thanks to more efficient use of working time, concentration, positive mood and an overall physical and psychologically healthier population.

Probably a substantial help will come from medical genetics, pharmaceutics and psychologic-psychiatric progress regarding *non-modifiable* risk factors such as age, sex and genetic make-up, and from urban-territorial planning and governance, politics and education regarding the *modifiable* risk factors such as environment (e.g. greener and less crowded-polluted cities) and life style (diet, sport, sleeping, hobbies, sociality, daily natural contact) part of it linked with the environment where one lives.

According to the large amount of empirical research evidence we saw, we can quite confidently say that urbanicity determines an approximately twofold increase in psychosis risk, and considering that in 2011 the urban world population was 52.1% and in 2030 it could be 60.4% (UN 2019) flatter to 62% the urban population along 2011-2030. Let's speculate that by planning better structural-infrastructural urban environments and forms (D'Acci 2019) and their socio-economic systems/life styles, (eliminating crowd-congestion, pollution, greenless, noise, crime, overwork, stress, over-pace…) of our current cities we are also able to entirely reduce their extra psychosis incidences and then levelling the urban psychosis rate to the rural one. After a few calculations based on the previous figures, we realise that we could save around US$ 7.4 trillion[3] (in GDP) in 20 years (2011-2030). If more prudently imagine to be able to reduce by even "only" 20% the urban rate of mental incidence by planning better urban environments, we would still save around one and half trillion dollars in 20 years.

If we refer to the cost-of-illness method (human capital) US$ 3 trillion[4] would be wasted in mental urban costs in one year alone (2030).

If we prefer to avoid forecasts so far away in time (2030) and refer our thoughts only to real data from the past, in 2010 the money *actually* spent for mental illness was US$ 2.9 trillion worldwide (2019 dollars). An amount also in line with the 4% of GDP costs for mental illness assessed by the 2018 OECD regarding Europe: in fact if we use this GDP percentage at the

[2] Especially after this Covid-19 pandemic.

[3] 0.62*2x + 0.38*x = 19.2 trillion; x≃11.9; 0.62*2*11.9≃14.8 trillion; half of them are ≃ 7.4 trillion; without considering capitalization issues under this flattered assumption.

[4] 0.714*2x + 0.286*x = 7.1 trillion; x≃4.14; 0.714*2*4.14≃5.9 trillion; half of them are ≃ 3 trillion.

world level, the world GDP in 2010 was around (in current dollars) US$ 66.037 trillion[5], whose 4% means US$ 2.64 trillion, namely around US$ 2.9 trillion in 2019 dollars. By following the previous reasoning about levelling the urban psychosis incidence to the non-urban one thanks to better urban planning and socio-economic life styles, the share of world urban population in 2010 was around 51.6%[6], therefore US$ 1 trillion[7] could have been saved in mental illness costs in one year alone.

In 2018 the world urban population was around 55.3% and the world GDP around US$ 85.8 trillion (current dollars), meaning roughly US$ 86.4 trillion today, whose 4% is US$ 3.46 trillion which, following the same approximate reasoning means that roughly US$ 1.3 trillion[8] could have been not spent in mental illness due to urbanicity issues. If we assume a reduction of "only" 20% of urban mental illness rate, we would still save around 260 billion dollars yearly.

To put these trillions in context, the entire Apollo Space Program (1961-1973), including the 1969 walks on the Moon, still one of the major humanity achievements, costed only around US$ 175 billion[9] (in 2019 dollars); almost 6 times less than what can be saved in only *one* year in mental illness due to *urban* life. An equivalent program but on Mars (sending nine crews), could cost around US$1.5 trillion[10], while the Mars 2020 rover mission costs 'only' between 2 and 3 US$ trillions. Another colossal human achievement, the 13 year Human Genome Project costed 'just' US$ 2.7 billion (1991 adjusted into 2018 dollars[11]).

Conclusions

Cities are a potentially great place to live and achieve our life's goals and progress, both as individual and as a species; however, it has some mental costs for the most susceptible. By planning better cities, territories and socio-economic daily life styles such as teleworking plus flexible working times, weekly working hour national reductions, greening cities and radically transforming the physical structures, forms and functioning of our current urban environments it would have an enormous potential economic impact environmentally, infrastructurally, but also psychologically speaking. From the academic literature we can say that the urban impact on mental health implies an approximately twofold increase in the rate of mental issues compared to the rural environment. Reports estimated a US$ 2.9 trillion global expense for mental disorders in 2010 alone and forecasted to become as high as US$ 7.1 trillion in the year 2030 alone. If we make a rather imaginative, although not that unrealistic, hypothesis to level the mental illness rate incidence of urban areas to these of the rural by better urban-societal planning, an astonishing amount of almost one and half trillion US dollars could be saved yearly: we could live happier, and send nine crews to Mars every year.

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[5] https://data.worldbank.org/indicator/ny.gdp.mktp.cd

[6] https://data.worldbank.org/indicator/sp.urb.totl.in.zs

[7] 0.516*2x + 0.484*x = 2.9 trillion; $x = 2.9/(1.032+0.484) \simeq 1.9$; $0.516*2*1.9 \simeq 2$ trillion; half of them are $\simeq 1$ trillion

[8] 0.553*2x + 0.447*x = 3.46 trillion; x = 3.46/(1.106+0.447) $\simeq 2.3$; $0.553*2*2.3 \simeq 2.544$ trillion; half of them are $\simeq 1.3$ trillion

[9] http://www.bbc.com/future/story/20190712-apollo-in-50-numbers-the-cost

[10] https://spacenews.com/op-ed-mars-for-only-1-5-trillion/

[11] https://www.genome.gov/human-genome-project/Completion-FAQ

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