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Green infrastructure as a disease prevention and rehabilitation tool

Key words: physical inactivity, economic burden, disease treatment cost

Introduction

In recent years, the social "green movement" has picked up its pace. People living in cities often complain about lack of greenery and fight to preserve every tree and patch of grass. Their arguments, like need for recreational spaces, places for children, adjustment to climate change and improvement of air quality, while valid, often fall on deaf ears. The main reason for that is, of course, additional expense connected to maintenance of greenery and costs of creating new parks, that municipalities do not always wish to bear. It is also a common perception, that it is more economically valid to dedicate unused areas to housing, commercial or industrial development. In this article, I would like to present several new arguments that might tip the scales in an ongoing struggle to keep our cities green.

This new "chance" for development of greenery comes directly from a medical sector and is connected to modern diseases. If we look at the list of top 10 causes of death provided by the World Health Organization, we will notice that the first two positions, ischemic heart disease and stroke, overshadow the rest, causing over a quarter of all deaths worldwide every year (Table 1). This list, of course, varies from country to country, however, this article tries to focus on high and middle income countries, as it will go over several disease factors that are not present in low income countries.

The reasons for this apparent epidemic are many. Over the years the medical sector researched the impact of smoking, drinking alcohol and unhealthy diet on this diseases (Scarborough et al., 2011). Recently however, one key factor has been gathering more attention and much more research began to admit it's critical role in modern "epidemics". This factor is, of course, physical inactivity (Blair & Morris, 2009). It lies in an area of general knowledge, that being active,

TABLE 1. Top 10 causes of death according to World Health Organization 2015 (WHO, 2017)

Cause	Deaths [million]	Share in deaths globally [%]
Ischemic heart disease	8.76	15.5
Stroke	6.24	11.1
Lower respiratory infections	3.19	5.7
Chronic obstructive pulmonary disease	3.17	5.6
Tracheal, bronchial lung cancers	1.69	3.0
Diabetes mellitus	1.59	2.8
Alzheimer disease, dementias	1.54	2.7
Diarrheal diseases	1.39	2.5
Tuberculosis	1.37	2.4
Road injury	1.34	2.4

helps us stay healthy, but perhaps the true value of physical activity has been, so far, underestimated. It is identified as a risk factor of not only ischemic heart disease and stroke but many others as well, including other positions from the top 10 lists like diabetes mellitus (Helmrich, Ragland, Leung & Paffenbarger, 1991) and Alzheimer's disease (Lautenschlager et al., 2008). This extends also to several forms of cancer (Farrell, Cortese, La Monte & Blair, 2007), osteoporosis (Greendale, Barret-Connor, Edelstein, Ingles & Haile, 1995), sarcopenia (Janssen, Heymsfield & Ross, 2002) and many others. Several authors from journal Lancet even went as far as to call it a "pandemic of physical inactivity" (Kohl et al., 2012). Of course each of the diseases warrants separate etiological research, but the impact of physical activity on overall health and disease prevention, especially in cases of ischemic heart disease and stroke, has already been established as critical (Gupta & Wood, 2019). What medicine tries to achieve now is a dramatic increase of physical activity among people who are especially prone to falling ill (Heath et al., 2012; Kohl et al., 2012).

Methodology

This article is a synthesis of 26 articles from the area of urban planning, medicine and socio-economic geography concerning the possibility of disease prevention via methods of urban planning. Data retrieved from articles is supported by statistics provided by World Health Organization, United Kingdom National Health Service, Polish National Health Fund and Institute of Innovative Economy from Poland. This review analysed the data in context of alternative methods of modern disease prevention and their economic validity. The author was able to distinguish physical inactivity as a common cause of the diseases in question and describe them in an introduction. The rest of the synthesis was split into two chapters explaining possible solutions for effective disease prevention

and contrasting their potential cost with current economic burden of this diseases on different national health funds.

A chance for greenery

According to the data gathered by the Polish Ministry of Health, the risk of falling ill from lack of physical activity, is greatly connected to age. For example, it is very rare, to encounter a case of ischemic heart disease before an age of 18, it is more likely to happen among young adults, with a risk of about 3% but the risk rises to 9–11% after the age of 44 and dramatically over the age of 54 to around 28%. This goes on even further after the age of 65 to a staggering 60% (Polish Ministry of Health, 2015). The same pattern can be found among cases of stroke and several others. It is no surprise, that with age, the amount of physical activity we undertake declines, however, in many cases it appears to disappear nearly completely, paving way for almost certain illness (Dalton, Warreham, Griffin & Jones, 2017).

In short, from a medical perspective, in order to significantly reduce mortality, it is necessary to increase the amount of physical activity among adults. In order to achieve that, one must possess data concerning the actual "effectiveness" of activity on disease prevention. How much of it and in what kind of environment must it be performed? What is the "bare minimum" that would keep an individual healthy.

Sadly, the total need for physical activity can perhaps never be fully calculated. It varies for every person. If inactivity is to be considered as one of the major factors contributing not only to diseases mentioned above, but also to obesity (Di Pietro, Dziura & Blair, 2004; Ding & Gebel, 2012), this would open a way to interpret it as a cause of even more premature deaths and years in disability, hence possibly increasing the need for it even further.

An important aspect of the mentioned need, is that it cannot be a random burst of activity, repeated for example once a month. It must be a force of habit, an everyday ritual, that does not keep an individual active sometimes, but all the time (Booth, Gordon, Carlson & Hamilton, 2000; Dalton et al., 2016; Gupta & Wood, 2019). This can include cycling few times a week, walking to workplace and back instead of driving, taking everyday strolls around the park, grocery shopping on foot etc. It is never mentioned that the performed activity must be challenging or strenuous. The goal here is not to achieve peak physical prowess, but simply stay healthy.

From a medical perspective, this rather unique challenge to endorse physical activity lies in a sphere of behavioural and environmental medicine. In hopes to adjust patient's behaviour and develop daily routine that would improve his or her condition, two factors must work in coherence (the figure).

First, in order to help patient, that is at a risk of falling ill, a doctor can and should prescribe him a certain amount of physical activity to be performed daily. For example 30 minute of walk every day, a practice that is already common in cardiology, and patients that are at risk of heart attack. This method is unfortunately incomplete without proper environmental intervention as countless

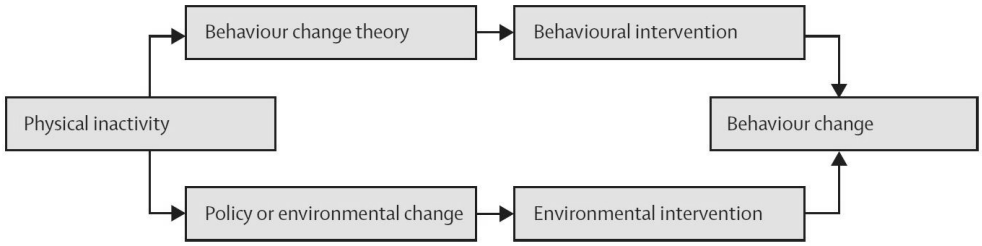

FIGURE. Behaviour change as a common goal of both behavioural intervention and environmental intervention (Kohl et al. 2012)

cases of illness prevalence go beyond biology and behaviour (Bauman et al., 2012). Each person requires not only reason and will to be physically active, provided by behavioural intervention, but also an opportunity to do so. This is where a chance for greenery and an environmental intervention steps in. Patient's surroundings must be adequate to facilitate the change of behaviour. And we must keep in mind, that health problems discussed here are chronic conditions and non-communicable diseases. People are not kept in hospitals, their surroundings are not limited to hospital grounds – they are streets, parks, housing districts, workplaces – cities.

In a review of contemporary urban planning and landscape architecture articles, we find, that accessibility (Paquet et al., 2013; Wang, Chau, Ng & Leung, 2016), presence of greenery and aesthetics are key requirements, that public spaces need to meet, in order to contribute to increased outdoor activity in cities (de Vries et al., 2003; Owen, Humpel, Leslie, Bauman & Sallis, 2004; Eronen et al., 2014; Dalton et al., 2016; Jansen, Ettema, Kamphuis, Pierik & Dijst, 2017; Keskinen, Rantakokko, Suomi, Rantanen & Portegijs, 2018). This warrants the creation of not only more green public spaces but more public spaces designed specifically to increase physical activity (White et al., 2016). In fact some authors were even able to produce a proto-guide to designing public spaces with this goal in mind, determining the impact of several design choices on physical activity (Wang et al., 2016). This presents a new challenge to urban planners, landscape architects and municipal planning offices as it is clear that they are not responsible for city's aesthetics, but public health. We can no longer treat access to green public spaces as a commodity but as a genuine medical need for a majority of our population.

Economic burden

Of course a rising concern about a subject of disease prevention is guided not only by health concerns but also economic costs, which lately appear to be the most important decision making factor. With access to modern knowledge base, it is possible to calculate the economic burden of many diseases. Such attempts have already been made in Poland. According to the report provided by the Institute of Innovative Economy (2017), Poland had from about 600 to 700 thousand people suffering from the risk of heart failure. This number is ex-

pected to rise by 250 thousand newly sick every year. Such large numbers are responsible for the costs of 757.4 million PLN (~176 million EUR) sustained by National Health Fund (NFZ) for patient treatment in year 2014. This cost grew annually by around 9% with 824.3 million PLN (~194 million EUR) in 2015 and 900.3 million PLN (~212 million EUR) in 2016. However, in order to provide a comprehensive report on economic burden, one must also take into the account indirect costs of a disease. This includes factors like premature death, disability, leaves of absence from work and countless other indirect results of sickness. This adds up to the total cost of 3,595 billion PLN (848 million EUR) in 2014 and 3,913 billion PLN (~921 million EUR) in 2015 (Institute of Innovative Economy, 2017).

At this point it is important to note that these are the reports concerning heart failure only and while indirectly connected, the burden of physical inactivity, especially in Poland, might differ greatly. However it would be possible to calculate the cost of physical inactivity in Poland like in case of Scarborough et al. (2011) who made an attempt to calculate it for United Kingdom (Table 2). The authors determined that the annual cost of physical inactivity taken by UK health service is around 659 million GBP. This number, however, is a product of considering physical inactivity as a risk factor of ischemic heart disease and ischemic stroke only. Additionally this numbers were not enriched by the sum of indirect costs.

Any attempt, to calculate full costs of society being physically inactive, would have to tackle with a massive amount of disease treatment costs of conditions, connected both directly and indirectly, to physical inactivity and by extension at

TABLE 2. Economic burden of physical activity and obesity on National Health Service in the UK in years 2002 and 2006/2007 (based on Scarborough et al., 2011)

Risk factor/Disease	Cost on National Health Fund 2002 [million GBP]	Cost on National Health Fund 2006/2007 [million GBP]
Physical inactivity		
Ischemic heart disease	526	542
Ischemic stroke	347	117
Obesity/Overweight		
Ischemic heart disease	778	801
Ischemic stroke	983	332
Breast cancer	29	59
Colon/rectum cancer	61	65
Hypertensive disease	576	2 121
Corpus uteri cancer	41	80
Osteoarthritis	229	853
Diabetes mellitus	533	835
Total	3 231	5 146

least partially – obesity. If the data is provided by the national health service, then it is also incomplete, not taking into the account the treatment from the private medical sector and not considering indirect cost on overall economy. It is also important not to overlook the psychological consequences of outdoor physical inactivity (Lautenschlager et al., 2008) and lack of access to green public spaces (Ströhle, 2009; Thompson et al., 2012). Lack of stress relief connected with outdoor activity can be responsible for yet another set of negative health consequences, including depression, anxiety and psychosomatic diseases (Sapolsky, 2012) and their total costs on our economy is even harder to grasp.

This leaves author with an impression that the real cost of physical inactivity cannot be fully calculated. This should not, however, discourage any attempts to determine the economic burden of selected factors, as it is clear that any successful endeavour will prove, that it is cheaper to invest now in green public spaces, designed to increase physical activity, than to treat patients in an ordinary fashion.

Recapitulation

In light of a modern epidemic of diseases of affluence and chronic conditions, physical inactivity has been determined as one of the most deadly risk factors. As it is a direct or indirect cause of countless diseases, an effort to increase physical activity among population has begun. Providing cities with more green public spaces has proven to be a viable method of facilitating the change of human behaviour from stagnant to active, leading to development of healthy habits. A challenge and chance lie now in spheres of medicine and urban planning to promote activity and provide adequate environment to perform it. Universal health benefits from this actions are paired with the a possibility of extreme relief from the economic burden on national health services and general economy. Author would like to suggest further research on a topic of cost comparison between green public spaces and standard patient treatment cost, including indirect costs of his sickness, in order to determine if it is cheaper to prevent diseases by providing specifically designed, green public spaces instead.

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Summary

Green infrastructure as a disease prevention and rehabilitation tool. This article tackles with the problem of preventing diseases caused by physical inactivity. It offers a brief review of deadliest diseases and defines critical role of green public spaces in their prevention. Article presents patient treatment costs, in contrast to the costs of organizing green public spaces, suggesting substantial relief from economic burden sustained by national health fund by offering green public spaces designed specifically for disease prevention instead of conventional treatment.

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