PRUSZYŃSKI, Jacek, CIANCIARA, Dorota, WŁODARCZYK-PRUSZYŃSKA, Inga, GÓRCZAK, Małgorzata and PADZIŃSKA-PRUSZYŃSKA, Irena. Indoor Generation Era. Risks and challenges. Journal of Education, Health and Sport. 2023;48(1):23-40. eISSN 2391-8306. https://dx.doi.org/10.12775/JEHS.2023.48.01.002
https://apcz.umk.pl/JEHS/article/view/46075
https://zenodo.org/records/10006094

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 17.07.2023 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).
Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 17.07.2023 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159.
Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
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The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 01.09.2023. Revised: 15.09.2023. Accepted: 16.10.2023. Published: 17.10.2023.

Indoor Generation Era. Risks and challenges

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Abstract

Our ability to remain in good health, both physical and mental, largely depends on the amount of time we spend out of doors. Certain changes to our lifestyle which came about due to technological progress have reduced the frequency of direct contact with the natural world and resulted in people remaining indoors for around 90% of their time. This has a negative impact on our health due to prolonged exposition to indoor pollutants, including light pollution on account of artificial lighting. A reasonable conclusion can be drawn that members of developed societies will, in the nearest future, continue to spend most of their time in various enclosed spaces. Because of this, in addition to taking steps aimed at motivating people to spend as much time as possible outside, we need to ensure that the conditions indoors are detrimental to us to the least extent possible and that the structural design of rooms where we stay supported our biological and mental needs.

Keywords: public health, indoor time, lockdown, anthropause, circadian circle, indoor pollution, remote work, outdoor activities, pet effect

Introduction.

Research into human mobility usually focus on migration, i.e. how people change the place where they stay. Consequently, they neglect one of the most important aspects of our mobility: movement in the course of everyday activities related to working or maintaining our household.

A typical plan of daily activities in the 21st century looks pretty much the same for all of us now: we wake up, we eat hastily in a poorly lit and insufficiently ventilated apartment, we spend eight or more hours at work, at a school bench, at a computer station, at an assembly line or at some type of

workplace with several breaks for keeping up with what has transpired in the meantime in "the world outside" via electronic media. Then we have another meal, do some household chores, spend several hours in front of a display of some kind and go to sleep. In spite of the fact that progress has made our lives easier by means of giving us new and improved tools, machines, and innovative technologies, it has also caused a drastic change in the way we live and behave. A considerable portion of the planet's population has, over the course of several decades, been freed from the burden of being directly involved with producing food. This facilitated migration to ever-growing agglomerations, conurbations, and metropoles. Working outside of the agricultural sector is associated with work performed indoors, in enclosed spaces. As a result of this process, many people spend most of their time in enclosed urban areas instead of out in the open, in a natural environment which would allow them to enjoy sunlight. Consequently, they lose their connection with the environment which their ancestors used to inhabit and their biological clock is more and more often disrupted. Such factors, when considered together, exert a negative influence on both the physical health of contemporary people and on their mental state, negatively impacting their well-being. Nowadays, researchers dedicate more and more of their time and attention to studying two core issues: how much time people spend in enclosed spaces (during work, in means of transport, while shopping, while socialising, and at home) and what impact this has on their health.

The results of a survey funded by the U.S. Environmental Protection Agency (EPA) (1) might serve as a good starting point - they form a set of input data which, in view of its relevance, is one of the most often quoted in publications. The study made use of interviews conducted over the phone to procure from its participants retrospective data about how they allocated their time during the preceding day. It was concluded that American people spend, on average, 87% of their time in enclosed rooms and around 6% of their time in various means of transport (2). Data prepared by Statistica on the basis of EPA National Human Activity Pattern Survey indicate that American people spend 74.1% of their time at home / at the office / at work (at a production plant), 11.0% of their time in other rooms, 5.5% of their time in means of transport, and 1.8% of their time in bars / restaurants. The average American person spent 7.6% of their time in an outdoor environment.

Further research showed that respondents remained in a room of some sort for 21 hours per day (i.e. 90% of the day) (3,4,5). Data presented in Indoor Time – Microenvironment – Activity Patterns in Seven Regions of Europe (6) are equally alarming - the study indicates that the people of Helsinki, Athens, Grenoble, Milan, Prague, and Oxford spend most of their time in enclosed spaces.

In Poland, data from the Public Opinion Research Center (CBOS) from 2012 (7) indicate that a professionally active Pole dedicated 46 hours per week to work on average. Additionally, he or she

would also commute to and from work for an average of 5 hours per week (this includes people whose work does not require commuting). The total amount of time assigned to professional activity thus goes up to 51 hours per week, i.e. around 10 hours per day, assuming a working week of five days (8). If we add 10-16 hours per week assigned to shopping, paying visits to friends and family members, visiting state institutions, and going to the doctor (9) and, on average, 8 hours of sleep per day and if we assume that household chores such as cleaning up, doing the laundry, meal preparation, and helping children with their homework take around 2 hours per day, the end result for Poles is similar to what we see in other modern societies. This means that the total amount of time we spend outside of enclosed spaces constitutes a very small portion of our overall time. The situation is similar in the case of the elderly people after they have retired - they spend entire days at home, many of them in solitude (10).

The COVID pandemics and anthropause.

The COVID-19 pandemics and the recommendation to stay at home associated with it, as well as restrictions affecting our freedom of movement imposed by some governments, further extended the amount of time we spend in enclosed spaces. This has had a major impact on the ways in which we spend our free time (11, 12, 13): there emerged many programmes promoting fitness activities at home (14), as well as social media challenges such as #StayHomeChallenge or #ToiletRollChallenge (15). What is more, numerous professional sports events migrated to online platforms (16). This substantiates a claim that lockdown-related restrictions have resulted in a major alteration of our behavioural patterns which could be referred to as "time spent in a digital environment." While the importance of digital incentives to remain fit and physically active even when forced to remain at home should not be underestimated, the major role the COVID-related lockdown has played in restricting our mobility outdoors also cannot be denied. The above-indicated alteration of behavioural patterns caused by the lockdown resulted in a phenomenon referred to as anthropause (17), the slowing-down of human activity. The anthropause period has had a major impact on the amount of time which had to elapse before mobility and the level of human activity gradually reached their pre-COVID levels. An example of such an impact are mental disorders which appeared or intensified during that time (18).

Remote work

Even though it cannot be said that the COVID-19 pandemics started an era of remote work, it was during the COVID-19 lockdown that employees realised en masse that working from home is much more convenient than working from the office. The new mode of work turned out to also benefit employers who realised that employees working remotely are just as effective as those working at the office. Consequently, though the popularity of remote work had

been on the increase even before the COVID-19 pandemics (19), the pandemics did reinforce that trend, effectively making it the new norm. This was a result of the technological progress which resulted in the emergence of a digital economy as part of which e-commerce and online teaching became another viable source of revenue (20,21). The emergence of virtual conference platforms such as Skype, Zoom, or Google Classroom, made it possible for teachers to interact with pupils and students without either of them having to physically appear in a classroom and online business meetings became so widespread and convenient that they are still commonly used by numerous institutions in both the private and public sector.

Virtual reality - one of the reasons indoor activities.

More and more people work in a way requiring considerable focus while they prepare materials, search for data, edit data, and correct data. Work like that does not combine well with frequent interruptions which only encourages such people to remain in enclosed spaces continuously with only short breaks. Such behavioural patterns are now adopted by people of various ages who spend the majority of their day at their computerized workplace while at the same time staying in touch with their peers whose situation is like their own. The virtual reality which can be generated by high class computers and smart digital TV sets and the development of mobile telephony mean that such people are more and more often content with viewing the external world only via the digital media they are surrounded with. Interacting with others through social media negates the need to engage in face-to-face direct meetings (22). According to a study carried out by PEW Research in 2023, around one-third (35%) of employees whose work allows them to work remotely work from home all the time. This is a significant increase compared to 7% from before the COVID-19 pandemics. Moreover, many employees performing hybrid work claim that they would also like to increase the share of the work they do remotely. Around one-third (34%) of people who now work remotely most of the time claims that they would switch to working from home all the time if they were given the choice to do so. As far as people whose work is partially performed online are concerned, half of them would like to work remotely all the time (18%) or most of the time (32%) (23). The sheer digital capacity and possibilities at our disposal resulted in both the creators of various online content and its recipients remaining in enclosed spaces for most of their time.

Consequences of staying indoors. Air in enclosed rooms and its impact on health.

The term “quality of air in rooms” (24) refers to the quality of air at home, at school, at the office, at one’s production plant workplace or in another artificially created environment. When asked about air

pollution, people usually think about areas surrounding big factories or busy urban areas with high levels of pollutants generated by cars. However, what impacts us the most is the quality of air in the enclosed spaces we stay in the most (25). Members of modern societies spend 90% of their time indoors (26), in rooms where the concentration levels of certain pollutants are sometimes 2 to 5 times higher than outside (27). People who are particularly vulnerable to and likely to be adversely affected by pollutants, such as the elderly, children, people suffering from circulatory or respiratory disorders, spend even more time in enclosed spaces (28,29).

The levels of concentration of pollutants in rooms have increased over several decades due to factors such as, among other things, buildings being constructed with saving energy in mind (i.e. with less focus on ensuring proper air circulation) and greater use of synthetic construction materials which might release volatile toxins over time (30,31). Common use of household chemicals and personal hygiene products inside rooms is also of no small impact (32).

Most pollutants influencing the quality of air in rooms come from sources inside buildings. Widely used products, such as cleaning agents, paints, and insecticides, introduce multiple chemical substances, including volatile organic compounds detrimental to humans, to our indoor environments. Potential sources of pollutants include construction materials (33) - whether as part of the process of their decomposition (e.g. substances released as insulation decomposes) or as a result of sublimation (e.g. from compressed wood products). Indoor pollutants could also be of natural origin (for example, moulds) (36). Harmful side products of combustion (e.g. carbon monoxide and solid particles) could be released from fireplaces and heating or cooking devices (37), especially if those run on synthetic fuels (38). Another important source of indoor pollution is tobacco smoke (39,40).

External pollutants may enter rooms through open doors and windows, ventilation systems, and cracks in structural elements. Some pollutants make their way into rooms from the foundations of buildings (for example, radon (41) which appears in places where uranium naturally present in rocks and soil decomposes). Volatile chemical substances can make their way into buildings in areas with polluted groundwater or soil (42). When people living in a given building use water (for bathing or taking a shower), chemicals present in water supply systems can make their way into rooms (43). There are many other factors influencing the quality of air in rooms, including the rate of air exchange, environmental conditions outside of said rooms, weather conditions, and the socio-economic status and behaviour of users of said rooms (44).

The most frequent health-related consequences of indoor air pollution include: irritation of the nose, eyes, and throat, headaches and dizziness, and tiredness. There are also documented instances of disorders affecting the respiratory and circulatory systems and tumours (45,46,47,48,49,50). An example illustrating the importance of indoor environment quality in enclosed

spaces is the “sick building syndrome” (51,52) which consists in different people suffering similar ailments after entering a specific building with those symptoms being alleviated or disappearing soon after they leave it.

There are also less known consequences of spending long hours indoors, ones related to the human body’s connection to the rhythm of nature and the daily behavioural patterns governed by the biological clock being severed, thus disrupting the body’s physiological attunement to the cycle of being asleep and awake. Exposition to the natural light/darkness cycle is a crucial element which our bodies need to function correctly (53). The intensity of light outside during the day falls somewhere between 10 000 and many dozens of thousands of lux, depending on cloud cover, while the intensity of light in most indoor environments is usually below 400 lux (54). Such levels of illumination are sufficient for us to perform our daily activities but they are not enough to regulate our biological cycles (55). Another typical feature associated with staying inside enclosed spaces for extended periods of time is the light pollution which results in incorrect application of activity/sleep cycles and de-synchronisation of the human internal clock not only with regard to the environment but also the rhythm of various processes (including hormonal processes) in interpersonal relations (56). This makes it more difficult to fall asleep and also interferes with physiological processes and metabolism which could lead to health-related issues (57). It can be reasonably demonstrated that those issues manifest themselves as disorders such as: increased frequency of occurrence of tumours, obesity, and type two diabetes - all of which are now considered diseases of affluence (58).

Recommendations: **behavioural, technical, and organisational**

According to researchers, children should spend 4-6 hours per day out of doors and at least 3 hours of outdoor playtime is recommended to ensure their correct development (59). As for adults, even though the mental and physical benefits of spending time outdoors (preferably in a natural environment) are highlighted in numerous articles (60,61,62,63), there is no clear-cut consensus as to the exact amount of time which needs to be spent outside for beneficial results. Data from different sources indicates that at least 10 to 30 minutes per day spent outdoors is beneficial for an adult (64,65,66,67). Even though there is an increasing number of studies indicating that staying out of doors, especially in a natural environment, improves our health and the way we feel (68,69), obligations related to our work and maintaining our households still often prevail over our efforts at going out and enjoying ourselves. Such efforts may become easier if we owned a dog - Maurice Maeterlinck described dogs as the only form of life to have formed an alliance with humans and they indeed have a considerable impact on increasing the amount of time their owners spend outside (70,71). Walking the dog on a daily basis requires physical activity from the owner and goes a long way towards disrupting the routine of everyday life (72,73). Owning a dog also opens up new opportunities related to outdoor sports. Jogging, Nordic walking, cycling, or dog obedience training - all those are not only bound to increase

the amount of physical exercise we do but also contribute towards building a better relationship with our four-legged companion (74). This is good for our health and helps us stay in shape and it is also beneficial for our mental well-being (75). There are also social benefits associated with owning a dog: dog owners, when walking their pets or participating in various events for pets, come into contact with other dog owners which facilitates forming social relationships (76). Owning a dog increases the frequency of our contacts with the natural world and the presence of a faithful companion makes every trip more enjoyable than simply going for a walk (77). To sum up, owning a dog gives us much more than simple companionship. It also encourages us to be more active out of doors, resulting in mental, physical, and social benefits. Looking after a pet gives the owner more opportunities to interact with the natural world and invites them to spend more time outdoors.

Since it can be assumed that in the future people will remain likely to spend considerable amounts of time in enclosed spaces, they should make sure that the environment within such spaces is as healthy for them as possible (78,79,80,81,82,83). Some of the commonly proposed solutions may seem trivial. In spite of that, regular cleaning coupled with reducing the use of chemical cleaning agents as much as possible, ventilating rooms at least three or four times per day and re-arranging interiors in such way as to maximise the amount of natural light reaching them is no less important. Similar, and equally important, recommendations include, as much as possible: leaving laundry to dry outside, switching oven hood's extraction fans on while cooking, closing the bathroom doors while taking a shower, and avoiding the use of candles, incense, or joss sticks inside rooms (84,85,86). The Environmental Protection Agency also recommends identifying and eliminating external sources of pollution by means of making foundations, roofs, walls, and floors airtight (87). Proper air flow needs to be ensured, especially for humid rooms because humidity facilitates the growth and spreading of moulds and saprophytes. Another important recommendation is to use non-toxic wooden floors and wood varnishes, as well as non-polluting or low-emission fitted carpets, wallpapers, paints, sealants, glues, and insulation. Attention should also be paid to ensuring that air vents and fuel-consuming devices such as gas stoves and central heating furnaces and bathroom heating devices are systematically inspected to guarantee their optimum functioning (88). Houses and apartments should be designed, built, and equipped in a way taking the needs of their future occupants into account and with the use of materials which pose no threat to human health. The Circadian House is an example of such design. Its purpose is to create rooms supporting the biological needs of their inhabitants. Such a house should include sufficient access to the external environment, make it possible to take advantage of natural light to the greatest extent possible and in line with the natural life rhythm, and guarantee protection against pollution (89,90,91).

Conclusion

Members of modern societies are, whether out of necessity or by choice, often forced to spend most of their time in enclosed spaces such as apartments, offices, means of transport, and educational facilities. This also applies to the elderly (92) who tend to be less active in any case. It has been proven that staying in enclosed spaces for extended periods of time can have a drastic impact on both physical and mental health (93,94,95,96,97,98). Insomnia, increased levels of aggression, irritability, lowered immunological defences of the body, increased vulnerability to circulatory, respiratory, and metabolic diseases, as well as a deterioration of social life are only some of the problems modern societies face. Those, at least in part, stem from decreased contact with the natural environment (99,100,101). Unfortunately, life in enclosed spaces is increasingly more common also among younger people who tend to derive less and less joy from interacting with the natural world and other people, choosing to spend their time in a virtual world instead. The digital age brought about by technological progress did make it possible for us to work remotely, study in the comfort of our own bedroom, and interact with others socially or enjoy entertainment online but it also made it necessary for us to take steps aimed at improving our indoor environments. It is important now to systematically spread information about the benefits of spending time outdoors and be active outside of one's own home. Owning a dog has the added benefit of encouraging its owner to spend more time outside and contributes to improving their physical and mental wellbeing.

Author's contribution:

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All authors have read and agreed with the published version of the manuscript.

Funding statement: The study did not receive special funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

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