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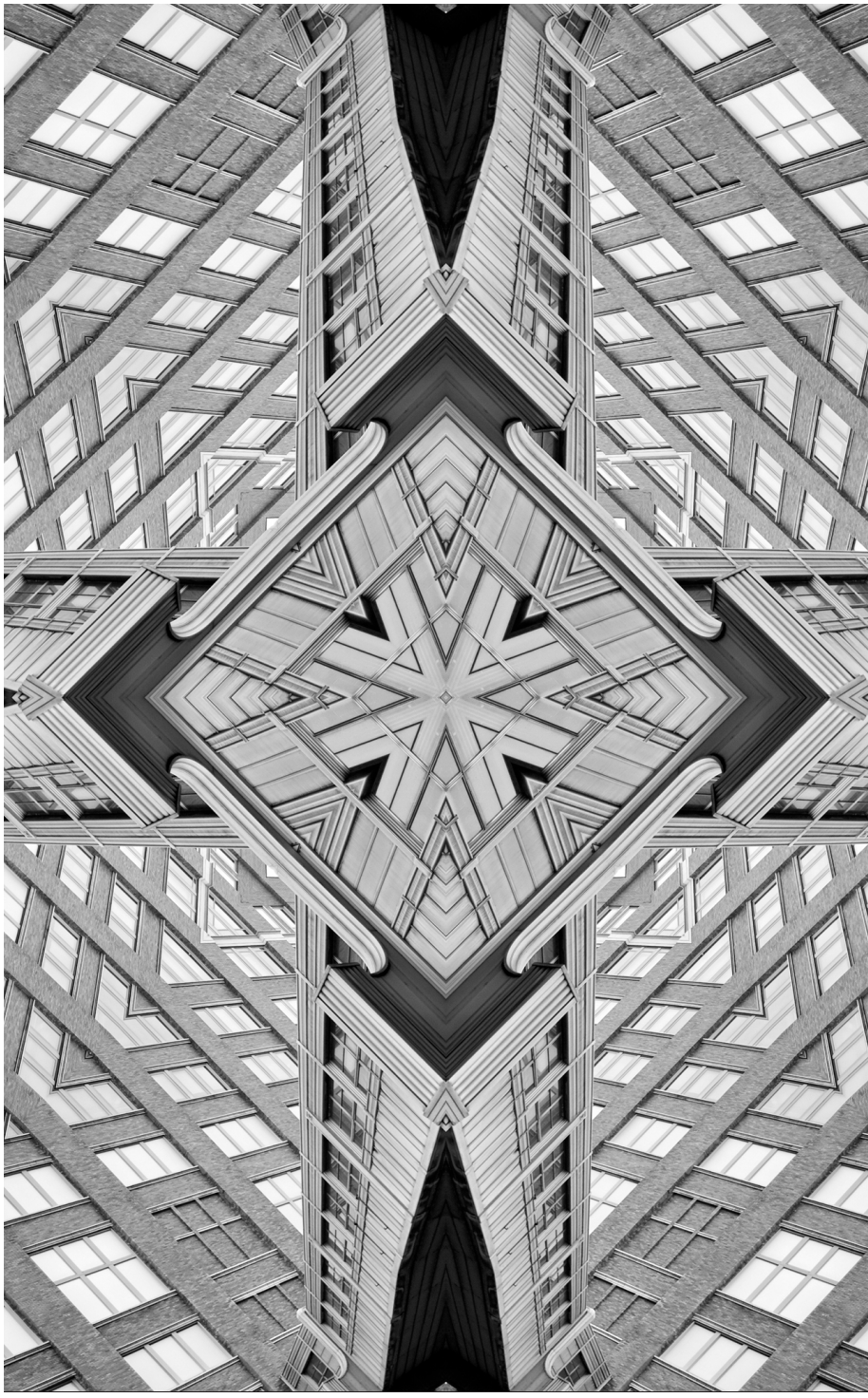

Sedentary Behaviour and COVID-19 Risk

Ekta Jain

Abstract

India's second COVID-19 wave was marked by a daily surge in incident cases and a high prevalence of severe forms of the novel coronavirus. COVID-19–related studies on Indian populations have focused on aspects like seroprevalence, estimating the peak of infections, and vaccine efficacy. However, other lifestyle factors, such as activity levels, are of significance and can broaden our understanding of COVID-19. Across the world, the pandemic life of quarantine and operating from home has led to the wide spread of sedentary lifestyles. There is strong evidence to suggest that mitigating sedentary behaviour can be an important public health strategy to avoid severe forms of COVID-19. This brief reviews this existing evidence and discusses sedentary behaviour and activity levels globally as well as for Indian populations.

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Introduction

The pandemic caused by the novel coronavirus continues to test medical and public health systems across the globe. The first COVID-19 wave in India in 2020 was relatively less intense as compared to most other parts of the world, where it spread unchecked. However, India's public-health systems did not anticipate the fury of the second wave, which witnessed record surges and a high prevalence of severe forms of the disease. Between April and May 2021, India witnessed an unprecedented 400,000 daily incident cases, with deaths peaking to around 5,000 for a particular day. These figures may well be underreported. The positivity rates climbed to record highs, reaching 50 percent in Bengaluru in Karnataka.

Breaking the chain of transmission had been the initial strategy in managing the pandemic. However, as the pandemic continued, the focus extended to reducing the severity of the disease. Public-health agencies pressed for the need for timely check of symptoms so that the infection would not progress and hospitalisations could be reduced.

Other changes have been observed as the pandemic has prolonged. When the World Health Organization (WHO) first declared COVID-19 as a pandemic, age (above 60 or 65 years) and underlying non-communicable diseases were identified as risk factors for developing severe forms of COVID-19.[1]

Other risk factors have been suggested since, and one such is *sedentariness*. An epidemiological study by Robert Sallis and colleagues at the Kaiser Permanente Medical Centre and Pomona College at the University of California, found that a sedentary lifestyle had been a factor in higher odds of hospitalisations, admissions to intensive care units, and death, in individuals who contracted COVID-19. This analysis lays down an important foundation for activity levels as a clinical predictor of the progression of the COVID-19 disease. Sedentary behaviour goes beyond being a behavioural or lifestyle risk factor in public health studies. It has clinical consequences as well. Indeed, its role in increasing the risk for cardio-vascular diseases and diabetes is already well-known.[2,3,4,5,6,7,8,9]

Sedentary Behaviour vs Physical Inactivity

Though the term 'sedentary behaviour' is often used interchangeably with 'physical inactivity', the two are different.[10,11] 'Physical inactivity' refers to insufficient levels of physical activity; 'sedentariness' or 'sedentary behaviour' is defined as any waking behaviour characterised by an energy expenditure that consumes more than 1 and less than 1.5 times the oxygen consumed when the body is at rest.[12] This is commonly represented in the form of a Metabolic Equivalent Task (MET) value.[13]

Sedentary behaviour is measured in terms of duration in minutes or hours per day or per week. Any measurement of sedentary behaviour does not take into account the intensity of the activity being performed. Physical activity, on the other hand, is any activity characterised by energy expenditure of more than 1.5 MET, and is further classified based on intensity of the activity. Some examples include walking at a slow speed, such as in one's office (2.0 MET), which is a light-intensity physical activity; sports such as cycling at 5.5 mph speed (3.5 MET), a moderate-intensity physical activity; and running at 5 mph (8.3 MET), a high-intensity or vigorous physical activity.[14]

Table 1: Sedentary Activities and their MET Values

	Activity Type (MET)
Sedentary	Lying quietly and watching television (1.0)
	Sitting at a desk, resting head in hands (1.3)
	Standing quietly, standing in a line (1.3)
	Reclining, reading (1.3)
	Sitting, writing, desk work, typing (1.3)
	Sitting, playing a traditional video/computer game (1.0)
	Sleeping (0.9)

Source: Compendium of physical activities [15]

For survey-based public health research, the compendium of physical activities essentially provides a system to classify activities and lists them along with their MET values.[16] This compendium serves as a resource that characterises activities by energy expenditure. Sedentary activities are mostly performed in a reclining, lying or seated position, such as writing, watching television, or playing a board game.[17,18] Public-health studies often capture television watching and using a computer as screen-viewing activity. (Most of these studies are based on high-income countries and have focused on children's screen-viewing times.)

The Canadian Society of Exercise and Physiology (CSEP) and Australia's national guidelines were the first available guidelines for sedentary behaviour. These guidelines, formulated after reviewing current published evidence at the time (including systematic reviews), were only incorporated with WHO's activity guidelines for November 2020. The WHO guidelines only mention total sedentary behaviour and mandate that prolonged sitting be reduced.[19,20,21]

Table 2: Sedentary Behaviour Guidelines

Children (5-11 years) and Youth (12-17 years) @$#	Limit prolonged sedentary time by breaking long periods of sitting. No more than 2 hours of screen time per day.
Adults (18-64 years) #	Reduce prolonged sitting and break periods of sitting often. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.

Source: Author's PhD thesis[22]

Sedentary Behaviour vs Physical Inactivity

@CSEP guidelines on physical activity.[23] Applicable to all healthy individuals pertaining to the specified age group. Individuals who are pregnant, disabled or have a medical condition should adhere after consultation with a medical practitioner. Not subject to differences in gender, ethnicity, race or socio-economic status.

$CSEP guidelines on sedentary behaviour.[24] Applicable to all healthy children and youth, not subject to differences in gender, ethnicity, race and socio-economic status.

#Australia's guidelines on physical activity and sedentary behaviour.[25] Note: Ages 1 to 5, are grouped separately. Guidelines mandate no screen time for those aged 2 years.

There are guidelines and recommendations on levels and intensity of physical activity that an individual should undertake to gain optimal health benefits as well as to maintain current health. In comparison to the guidelines for minimising sedentary behaviour, those for promoting physical activity are more developed. This also finds basis in the types of activities classified as 'physical activity'. For sedentary behaviour, the number of activities enlisted are a handful but can account for a larger proportion of one's day. For example, sitting is a sedentary activity and can easily be performed for six to eight hours per day. The main takeaway from the sedentary behaviour guidelines is that individuals should reduce sedentary behaviour to derive health benefits.

Sedentary Behavior and Covid-19 Severity

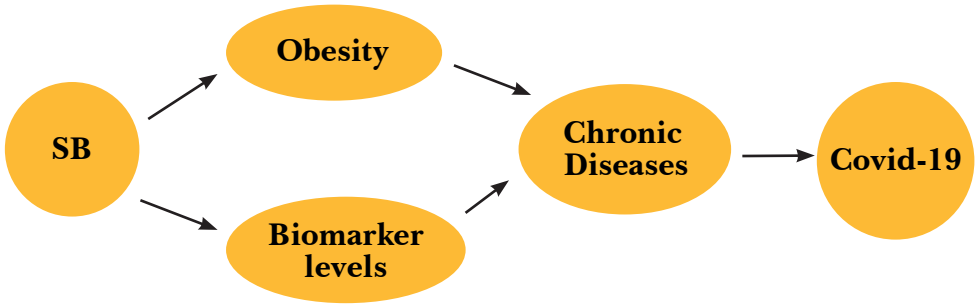
A landmark study by Robert Sallis and other researchers,[26] published in 2021 in the *British Journal of Sports and Medicine*, established a causal positive relationship between sedentariness and COVID-19 disease severity. Sallis and his colleagues investigated risk factors in 48,400 adults (aged >=18 years) who contracted COVID-19 between 1 January 2020 and 21 October 2020. The study participants were recruited from Kaiser Permanente Southern California (KPSC), a healthcare system in California that serves 4.7 million people across 15 medical centres in the southern regions of the state. The diagnosis of COVID-19 was based on the gold-standard RT-PCR tests. This was a retrospective analysis; the researchers collected data from individuals with a minimum of three outpatient visits and activity measurements records between 19 March 2018 and 18 March 2020, just before the COVID-19 lockdown in California. These KPSC health-plan members had been asked about their levels of activity over the past two months. This was captured using two simple questions: 1) "On average, how many days per week do you engage in moderate to strenuous exercise (like a brisk walk)?" and 2) "On average, how many minutes do you engage in exercise at this level?"

Based on the responses, three levels were created: consistently inactive (performing 0–10 minutes of moderate to strenuous activity per week); some activity (performing 11–49 minutes of moderate to strenuous activity per week); and consistently meeting physical activity guidelines (performing 150 or more minutes of moderate to strenuous activity per week).

Logistic regression analysis showed that consistently inactive individuals were 2.26 times more likely to be hospitalised than those infected individuals who were meeting physical activity guidelines. Such consistently inactive individuals were also 1.73 and 2.49 times more likely to be admitted to the ICU, and succumb to the illness, respectively, as compared to consistently active individuals. The odds for hospitalisation, admission in ICU, and death were also higher for those who were inconsistently active (performing 11–49 minutes of moderate to strenuous activity per week), as compared to those meeting physical activity guidelines.

These findings controlled for smoking, underlying conditions and other co-morbidities. What this means is that, in reality, the odds of sedentariness were likely to be higher than reported because of the variables that the analysis adjusted for. Variables such as diagnosis of diabetes, cardiovascular diseases and other chronic conditions are associated with a higher risk of COVID-19 severity. These variables share activity levels as a risk factor; sedentary behaviour exacerbates these chronic conditions. Adjusting for them in the analysis reduces the direct effect that activity levels would be seen to have on COVID-19 disease severity. Let us understand this from the following directed acyclic graph.

Figure 1: Directed Acylic Graph: Sedentary Behaviour and COVID-19*



Source: Author's own, using available evidence. [27,28,29,30,31,32,33,34,35]

** Severe forms of COVID-19*

Sedentary Behavior and Covid-19 Severity

Sedentary behaviour (labelled 'SB' in the diagram) can cause obesity and unfavourable levels of biomolecular markers such as blood pressure, blood glucose, cholesterol (in particular, low density lipo-protein) and insulin.[36] These molecular measurements are well-established biomarkers of various chronic conditions such as cardiovascular diseases and diabetes.

Evidence demonstrates that breaking prolonged sedentary behaviour with light- or moderate-intensity activity is beneficial to metabolic biomarkers. Reduced sedentary behaviour is beneficial for systolic blood pressure levels, blood insulin and high-density lipoprotein levels;[37] standing office work improves glucose levels;[38,39] cycling and walking helps improve lipids, insulin[40] and glucose levels.[41]

> "Variables such as diagnosis of diabetes, cardiovascular diseases, and other chronic conditions are associated with a higher risk of COVID-19 severity. Sedentary behaviour exacerbates these chronic conditions."

Sedentary Behaviour: Global Patterns

Worldwide, studies of sedentary behaviour levels highlight that on average, 42 percent of adults spend a minimum of four hours per day sitting.[42] In particular, this proportion was found to be around 37 percent for African countries, 55 percent in the US, 64 percent in Europe,[43] and 37 percent in Singapore.[44] These trends are not unique to urban settings. Almost 80 percent of adults in rural Sweden showed high sedentary behaviour.[45] Estimates using data from 34 countries show that the average time spent in screen-viewing is three hours per day.[46]

Globally, the prevalence of physical inactivity is also high—around 27.5 percent of individuals aged 18 years and above are physically inactive. This finding is based on 1.9 million participants from 168 countries.[47] Estimates of physical inactivity were found to be high across the US (43 percent), Europe (38 percent), Africa (27 percent), and Southeast Asia (17 percent).[48]

The COVID-19 pandemic has subjected populations to a life of self-isolation and quarantine. Such a drastic and sudden change has impacted levels of physical activity and sedentary behaviour worldwide. Populations have become more sedentary and physically inactive.[49,50,51] Several studies show that sedentariness is on the rise in both children and adults.[52,53,54]

In 2013, WHO acknowledged increasing levels of global physical inactivity and attributed costs of around USD 54 billion to global physical inactivity per year in direct healthcare.[55] The national healthcare burden owing to physical inactivity is estimated to be around one to three percent. Following calls to build a policy framework aimed at increasing levels of physical activity, WHO instituted the Global Action Plan on Physical Activity in 2013, which had a mandate of relative reduction in physical inactivity by 10 percent by 2030. However, this target was increased to 13 percent in 2017, and further to 15 percent in 2020 based on current progress on management of non-communicable diseases (NCDs) and levels of physical inactivity. The Action plan recognises the need for a systems-approach to achieve its targets by creating active societies, environments, people, and systems.[56]

India Studies on Sedentary Behaviour and COVID-19

Most of the studies in India on COVID-19 have been from the All India Institute of Medical Sciences and the Indian Council of Medical Research.[57] They have largely focused on disease virology, diagnosis, transmission, seroprevalence, treatments, and mortality.[58,59]

However, there is little yet known about the lifestyle risk factors for COVID-19 in Indians.[60] Pre-COVID, too, sedentary behaviour studies on Indian populations were limited. These limited studies report high levels of sedentary behaviour in India.[61,62,63,64] Important analyses that have measured physical inactivity have also reported high levels.[65,66,67] Such findings were primarily based on urban children and adults. For adults in rural settings, evidence showed an equally high 40-percent prevalence of sedentary behaviour.[68]

> "Studies of sedentary behaviour levels highlight that on average, 42 percent of adults spend a minimum of four hours per day sitting."

Discussion

There are some points to consider in Sallis and his colleagues' analysis. First, the study design and sample size speak to the strength of the analysis. Though data collection was retrospective, the analysis was prospective, as the exposure (activity levels) were assessed before the outcome (COVID-19 disease severity). Thus, one can safely assume causality—the ultimate goal when identifying risk factors for any disease in an epidemiological study. The evidence is based on data collected from 40,344 individuals, which is a large sample size for a public-health study measuring activity levels.

Another point to consider is that the Sallis study used a two-question list that has been previously validated and used.[69,70] Measuring sedentary behaviour separately (in detail) and/or physical activity levels involves the use of lengthy questionnaires that require time to administer and are costly. Further, the data collected by such questionnaires is self-reported, subjective measurements. Self-reported measures tend to over-report physical activity and under-report sedentary behaviour.[71] This limitation can be addressed with the use of objective measurements involving wearable devices. However, this is not without its own set of challenges, one of which is compliance. Overall, measuring activity levels, just like any other measurement, are susceptible to bias. However, as long as a public-health study can identify the biases and understand how they may affect results, the findings can be considered and used as an opportunity to plan future studies.

A third aspect to acknowledge is that the authors measured and investigated physical inactivity as opposed to directly measuring sedentary activities (sitting, watching television, or lying down). Individuals with high levels of physical inactivity tend to have high sedentary behaviour, too. Both sedentary behaviour and physical inactivity are relatively easier to modify, as compared to increasing levels of physical activity. Evidence demonstrates that changes in reducing sedentary behaviour do not need to consider differences in age, gender, occupation or socio-economic status.[72,73] For example, an elderly retired individual with high sedentary behaviour can reduce the time spent lying down reading or watching television. A young professional in a mostly sedentary occupation can break the pattern of sitting by standing up every so often or taking short walks around the office floor. Reducing sedentary behaviour is a simple behavioural intervention as compared to increasing physical activity by, say, playing more sports, increasing intensity of walking, or increasing the frequency of any given physical activity. Nonetheless, a direct and more accurate measure of sedentary behaviour will serve as formal evidence for the role of sedentary behaviour or being less sedentary in the management of COVID-19.

Conclusion

Studies on lifestyle factors for an Indian population are so far limited. They have aimed to describe levels of activity during the pandemic, and have not looked at activity levels as a risk factor of COVID-19. Mostly, these studies were conducted within a short period, ranging from three days to three weeks—[74,75,76,77,78] which is not sufficient to capture levels that are true, or at least closer to true. Analysing lifestyle risk factors, such as activity levels, can aid the management of COVID-19 in India. Sedentary behaviour is an independent risk factor for chronic diseases.[79,80] Irrespective of one's levels of physical activity, a high level of sedentary behaviour is detrimental to molecular levels of biomarkers of various chronic conditions[81] that are known to worsen a COVID-19 diagnosis.

The intense second wave in India happened more than a year after the first one. The population was already exposed to pandemic life. As reported from other parts of the world, the pandemic life probably made lifestyles only more sedentary. This may have contributed to the high numbers of severe COVID-19 cases in the country. It is, however, difficult to assume the magnitude and strength of such a relationship without a sound epidemiological study design. Moreover, the limited studies on Indian population captured physical activity levels and not sedentary behaviour.

The results of the study by Sallis and colleagues were adjusted for underlying chronic co-morbidities; the effect of sedentary behaviour on COVID-19 in individuals without co-morbidities is likely to be even more pronounced. This suggests that low sedentary behaviour may also prevent a severe form of the COVID-19 disease in individuals, whether or not there is presence of co-morbidities. The evidence from the study by Sallis and colleagues is strong and suggests that mitigating sedentary behaviour can be an important public health strategy to manage COVID-19 disease severity and the pandemic life of operating from home and keeping in quarantine. The imperative is to conduct further studies that review activity levels in Indian populations. These studies need to focus, in particular, on those who test positive for COVID-19, and must explore the association between COVID-19 and activity levels.

Ekta Jain *is an epidemiologist. Her PhD dissertation investigated physical activity and sedentary behaviour, and associations with NCDs and urbanisation in peri-urban Indians.*

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