



Sedentary lifestyle and remote working as predisposing factors for cancer development

Siedzący tryb życia oraz praca zdalna jako czynniki predysponujące do rozwoju nowotworów złośliwych

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Abstract

Introduction and Objective. A sedentary lifestyle and the widespread practice of remote working are becoming increasingly common in society. Reports highlight their association with the development of various diseases, including cancer. The aim of this study was to analyze the available literature and determine the real impact of sedentary lifestyle and engagement in remote working on the development of cancer. Such an analysis is essential as cancer-related diseases are becoming an increasingly serious societal issue. Preventive measures are also presented. The study also presents preventive measures, the implementation of which could potentially minimize the risk of developing these diseases.

Brief description of the state of knowledge. People are increasingly adopting sedentary lifestyles from a young age. Remote working has gained popularity in recent times, contributing to the strengthening of this trend. A sedentary lifestyle can have adverse effects on both mental and physical health, leading to the development of various diseases, including obesity, diabetes, and cardiovascular diseases. However, there is growing evidence of a correlation between a sedentary lifestyle and cancer, which is becoming more prevalent in society. Recommendations are also available for reducing sedentary behaviour and, consequently, the development of certain diseases, including cancer.

Summary. A sedentary lifestyle and remote working are risk factors for many diseases, including cancer. It is essential to take actions to limit the adoption of such lifestyles as which. Further research is needed to precisely determine the relationships between these phenomena.

Key words

cancer, risk factors, physical activity, cancer risk, sedentary behaviour, remote work

Streszczenie

Wprowadzenie i cel pracy. Siedzący tryb życia oraz związana z nim praca zdalna są coraz bardziej powszechne w społeczeństwie. Znane są doniesienia dotyczące ich związku z rozwojem wielu chorób, w tym nowotworów złośliwych. Celem pracy było przeanalizowanie dostępnej literatury oraz określenie realnego wpływu siedzącego trybu życia oraz pracy zdalnej na rozwój tychże nowotworów. Przeprowadzenie takiej analizy jest istotne, gdyż choroby nowotworowe stanowią coraz poważniejszy problem społeczny. Przedstawione zostały także działania zapobiegawcze. Ich podjęcie mogłoby zminimalizować ryzyko rozwoju wspomnianej choroby.

Opis stanu wiedzy. Ludzie coraz to częściej już od najmłodszych lat prowadzą siedzący tryb życia. W ostatnim czasie coraz większą popularnością cieszy się praca zdalna, która przyczynia się do wzmocnienia tego zjawiska. Siedzący tryb życia może niekorzystnie wpływać na zdrowie psychiczne i fizyczne. Prowadzi do rozwoju wielu chorób, w tym otyłości, cukrzycy czy chorób układu krążenia. Istnieje jednak coraz więcej doniesień na temat korelacji pomiędzy siedzącym trybem życia oraz chorobami nowotworowymi, które coraz częściej występują w społeczeństwie. Znane są również zalecenia, które można wdrożyć, by ograniczyć prowadzenie siedzącego trybu życia, a tym samym rozwój niektórych chorób, w tym chorób nowotworowych.


Podsumowanie. Siedzący tryb życia oraz praca zdalna są czynnikami ryzyka wielu chorób, w tym chorób nowotworowych. Niezbędne jest podejmowanie działań ograniczających prowadzenie takiego trybu życia. Potrzebne są także kolejne badania, które pozwolą dokładnie określić zależności pomiędzy tymi zjawiskami.

Słowa kluczowe

czynniki ryzyka, aktywność fizyczna, nowotwór złośliwy, siedzący tryb życia, ryzyko nowotworu, praca zdalna

INTRODUCTION

Sedentary behaviour is defined as any waking behaviour in which energy expenditure is less than 1.5 metabolic equivalents of task (METs), while sitting, reclining, or lying down [1], which can be measured by screen time and

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accumulated sitting time [2, 3]. Among the causes of reduced activity, can be listed the lack of leisure-time physical activity, a sedentary lifestyle at home or work, and the use of passive means of transportation [4]. The decline in physical activity has affected the workplace over the years, with an increase in sedentary tasks and opportunities for remote working [3, 5]. With the onset of the Covid-19 pandemic, the number of people working from home increased rapidly; however, this form of work carries serious consequences, both for mental and physical health. It is worth noting that health-related matters receive less attention compared to analyzing results and employee productivity [6]. According to data from the WHO, over 25% of the adult global population, which amounts to 1.4 billion adults, is insufficiently active, with one in three women and one in four men failing to engage in adequate physical activity necessary for maintaining good health. A greater decline is observed in higher-income countries compared to lower-income countries [4].

A sedentary lifestyle is strongly linked to cardiovascular diseases, diabetes, cancer, and premature mortality [7–10]. Over time, there has been a noticeable rapid increase in the incidence and prevalence of cancer worldwide. In 2008, there were 12.7 million new cancer cases and 7.6 million deaths attributed to it, compared to 18.1 million new cases and 9.6 million deaths in 2018 [11, 12]. Although a sedentary lifestyle and lack of physical activity are separate concepts, it is not yet fully understood whether and to what extent a sedentary lifestyle acts as an independent risk factor for cancer, apart from physical activity [11].

Through this exploration, it is hoped that light will be shed on the complex dynamics at the intersection of a sedentary lifestyle and development of cancer. By providing information about the nature and characteristics of specific diseases, this review article also draws attention to the scale of the problem and present specific recommendations for effectively reducing the risk of these disorders.

MATERIALS AND METHOD

An extensive search was conducted across various online databases, including Google Scholar and PubMed. To identify relevant articles, a combination of search terms and phrases was employed, such as 'sedentary lifestyle', 'remote working', 'cancer', 'physical activity', 'risk of illness', 'cancer risk', 'consequences of remote working' and 'correlations between sedentary lifestyle and the risk of illness'. A total of 134 articles were analyzed, from which 48 were selected as the most pertinent to the study, thus ensuring that the research focused on how a sedentary lifestyle influences the development of cancer. The selected cancers were most frequently examined for their correlation with a sedentary lifestyle. The chosen articles underwent a thorough review and analysis to gain a comprehensive understanding of the challenges and best practices associated with preventing a sedentary lifestyle and, thereby, reducing the risk of cancer development.

Consequences of remote working and sedentary lifestyle. Due to the advancement of information technology and globalization, remote working from home has gained significant importance [3, 13]. It has been intensified and confirmed as a practical tool for employee protection and sustaining economic activities, particularly in the context of

the crisis caused by the Covid-19 pandemic [3, 14]. Fukushima et al. found that remote workers were less physically active and spent more time sitting compared to those working on-site [15]. Imran et al. in their study which examined the correlation between television watching time and all-cause mortality, demonstrated that individuals who watched television for ≥ 6 hours daily had a two-fold higher risk of mortality from any cause, compared to those who watched television < 2 hours daily. Furthermore, for individuals who watched television for ≥ 4 hours daily, the risk of mortality from any cause was 1.5 times higher than those who watched television < 2 hours daily [16, 17].

Sedentary lifestyle affects the human body in various ways. Many researchers have shown that a sedentary lifestyle leads to metabolic dysfunction, such as elevated triglycerides, decreased high-density lipoproteins (HDL), and reduced insulin sensitivity [16, 18–20]. It also leads to a decrease in lipoprotein lipase, muscle glucose, carbohydrate metabolism, and lipid metabolism disorders [16, 19]. It results in microcirculation disturbances, a decrease in cardiac minute volume, sympathetic nervous system activation, and elevated blood pressure [9, 16, 19, 20]. A sedentary lifestyle also affects the insulin-like growth factor axis and sex hormone levels, leading to an increased incidence of hormone-related cancers. It also poses a risk of weight gain and obesity [16, 18–20]. Zerwekh et al. demonstrated in their study that 12 weeks of bed rest led to a significant increase in the resorption of cortical and cancellous bone [21]. Biswas et al. conducted a meta-analysis and found that a sedentary lifestyle was independently associated with a higher risk of cardiovascular diseases, cancer incidence or mortality (breast, colon, colorectal, endometrial, and ovarian epithelial cancers), and type 2 diabetes in adults. They also found that the harmful effects of a sedentary lifestyle generally decreased among individuals who were more physically active compared to less active individuals [10].

Given the increasing popularity of a sedentary lifestyle and the spread of cancer, numerous studies have been conducted to determine the relationships between these phenomena.

Correlation between sedentary lifestyle and cancer risk. Over the years, the global incidence of cancer has risen dramatically [22, 23]. Sung et al., in their study based on GLOBOCAN 2020 estimates, found that in 2020, there were 19.3 million new cancer cases and nearly 10 million deaths due to this disease. Cancer is a significant cause of morbidity and mortality in every region worldwide, regardless of the levels of human development [24]. To reduce cancer incidence, preventive measures are essential, as well as understanding the factors predisposing to cancer.

Friedenreich et al. noted that over 500 observational epidemiological studies have been conducted which examined various aspects of the relationship between physical activity and cancer incidence [25]. One of them is the prospective cohort study conducted by Lin et al. which found that a sedentary lifestyle was associated with an increased risk of cancer and all-cause mortality among Chinese adults, particularly in individuals who had a sedentary lifestyle for > 10 hours daily [26]. The most frequently described cancers that correlate with a sedentary lifestyle included ovarian, prostate, rectal, and lung cancers. The 2019 update by the PAGA Committee stated that there is moderate

evidence suggesting that a high level of sedentary behavior is associated with an increased risk of colon, endometrial, and lung cancer. Strong evidence was also presented that the detrimental effects of a sedentary lifestyle are more pronounced in physically inactive individuals [27].

Despite numerous studies, controversies and inconclusive results persist, varying with the type of cancer and the particulars of one's lifestyle. Analyzing the specifics of individual cancers is therefore necessary.

Ovarian cancer. Ovarian cancer is the eighth most common cancer in women worldwide, with 295,414 cases and 184,799 deaths in 2018, and 21,750 new cases in 2020, accounting for 1.2% of all cancer cases. It is one of the leading causes of cancer-related deaths among women in developed countries. Due to non-specific symptoms and the lack of effective screening methods, ovarian cancer is often diagnosed at an advanced stage, resulting in low survival rates [12, 28–31].

Over time, many studies have examined the association between ovarian cancer and a sedentary lifestyle. Biller et al. conducted a meta-analysis involving 2,060 cases of ovarian cancer from seven studies which revealed a 29% increased risk of ovarian cancer with high sedentary behaviour, compared to low sedentary behaviour [29]. Buras et al. also investigated this relationship and found an increased risk of ovarian cancer in women who spent 10–19 hours and ≥ 20 hours per week sitting at work, compared to those sitting < 5 hours per week. This relationship was not affected by body mass index, physical activity, or histotype [32].

Further research is needed to confirm these findings and elucidate the underlying mechanisms. Early diagnosis of the disease is crucial to improve the chances of cure, and reduce the incidence and mortality rates [29, 32].

Colorectal cancer. According to data from the WHO, colorectal cancer is the third most common cancer globally, accounting for approximately 10% of all cancer cases. It is the second leading cause of cancer-related deaths worldwide, primarily affecting individuals aged 50 and over. Risk factors for colorectal cancer include high consumption of processed meats, low intake of fruits and vegetables, obesity, smoking, excessive alcohol consumption, and a sedentary lifestyle [33].

Cong et al. conducted a meta-analysis to determine whether a sedentary lifestyle is associated with the risk of colorectal cancer. They examined 12 prospective cohort studies, totaling 30,810 cases of this cancer. The analysis found a statistically significant association between a sedentary lifestyle and an increased risk of colorectal cancer. Subgroup analyses suggested a positive relationship between a sedentary lifestyle and the risk of this type of cancer in cohort studies. This leads to the conclusion that reducing a sedentary lifestyle is potentially important in preventing colorectal cancer [34].

Boyle et al. explored the relationship between long-term sitting work and the risk of location-specific colorectal cancer. They demonstrated that individuals who spent 10 or more years in sedentary work were nearly twice as likely to be at risk of cancer in the distal colon, compared to those who did not have sedentary jobs. They were also 44% more at risk of rectal cancer. This relationship was independent of recreational physical activity and occurred even among the most physically active participants. It was concluded that sedentary work was not necessarily associated with the risk of proximal colon cancer [35].

Analyzing these results, it can be concluded that long-term sedentary work may increase the risk of distal colon and rectal cancer.

Prostate cancer. Prostate cancer is the second most common cancer in men, accounting for 13.5% of all cancer cases in men worldwide [12]. Risk factors for its occurrence include age, family history of prostate cancer, and ethnicity [12, 24, 36]. There is increasing evidence that a higher amount of adipose tissue is associated with the risk of advanced prostate cancer. More attention is being given to the relationship with additional modifiable risk factors, such as diet and physical activity. Among them, a sedentary lifestyle has been identified as a potential determinant of prostate cancer risk [37].

Berger et al. conducted a meta-analysis analyzing data from 12 prospective cohort studies, including a total of 30,810 cases of prostate cancer. They found no statistically significant relationship between high or low levels of sedentary behaviour and the occurrence of prostate cancer. Adjustment for body mass index (BMI) influenced the relationship between a sedentary lifestyle and this type of cancer, particularly aggressive prostate cancer. A statistically significant increased risk of aggressive prostate cancer was observed in analyses which did not account for BMI, whereas no such relationship was found in analyses that did take BMI into account. Consequently, it was concluded that a sedentary lifestyle is not independently associated with prostate cancer. Nonetheless, prolonged sedentary behaviour may be associated with a higher risk of aggressive prostate cancer through mechanisms related to obesity [38].

Lynch and colleagues conducted a study to examine the potential relationship between self-reported daily sitting time and daily television/video-watching time and the risk of prostate cancer incidence or mortality among 170,481 men in the NIH-AARP Diet and Health Study. They did not observe a strong or significant relationship with prostate cancer risk in fully adjusted models, whether for daily sitting or television/video-watching time. They also attempted to modify the analysis by considering body mass index (BMI). In this case, the overall risk of prostate cancer was slightly elevated, but not significantly increased among obese patients. No relationship was observed among overweight patients, while in men with a normal BMI, watching television or videos was associated with a no-significant reduction in risk [39].

Lung cancer. According to data presented by the WHO, lung cancer is the leading cause of cancer-related deaths worldwide, and is responsible for the highest mortality rates in both men and women. It is often diagnosed at an advanced stage when treatment options are limited. Primary prevention, including tobacco control and reducing exposure to environmental risk factors, is essential for decreasing the incidence of lung cancer and saving lives [40].

The study conducted by Jiang et al. aimed to prospectively examine whether total sitting time during the day, on its own or in combination with physical activity, is associated with the overall incidence of lung cancer and its histologic subtypes. Lung cancer developed among 549 participants from a total of 45,810. Total daily sitting time was not associated with the overall incidence of lung cancer or its histological subtypes. Participants who sat for less than eight hours per day and were physically active had a higher risk of lung cancer, compared to

those who sat for at least eight hours a day without physical activity. The results indicated that prolonged sitting or lack of physical activity alone was not associated with lung cancer risk. Therefore, it was concluded that prolonged sitting is not independently associated with the occurrence of lung cancer, but the combination of prolonged sitting and lack of physical activity may increase the risk [41].

The WHO promotes various strategies for cancer prevention – including lung cancer. These strategies involve advocating a healthy lifestyle, regular physical activity, a healthy diet, and minimizing exposure to environmental risk factors [40].

Prevention. Estimates of the population burden associated with modifiable risk factors and cancer incidence have shown that 30–40% of cancers are potentially preventable [25, 36, 42–44]. Moreover, there is a significant economic cost that could be prevented by reducing the frequency of modifiable risk factors, including a sedentary lifestyle, lack of physical activity, or obesity [25, 45].

Ekelund et al. conducted a meta-analysis involving over 850,000 participants which showed that physical activity modified the relationship between a sedentary lifestyle and cancer-related mortality. The study also indicated that a sedentary lifestyle has consistent adverse effects on individuals with low levels of physical activity. The authors concluded that physical activity modifies the associations between a sedentary lifestyle and cancer-related mortality [46].

For a long time, public health programmes have focused mainly on physical activity. Messages advocating the reduction of a sedentary lifestyle are much less common and require significant attention [10]. Lie et al. in their work emphasize that public health programmes and policies should not only promote physical activity, but also advocate the reduction of time spent in sitting, thus preventing the occurrence of cancer and premature mortality [26]. The WHO has issued recommendations for different age groups on how to prevent the negative effects of a sedentary lifestyle (Tab. 1) [47].

The results presented in this review study confirm the need for increased public awareness of the risks associated with a sedentary lifestyle, and justify further research to assess the effectiveness of interventions that limit sitting time independently of physical activity, or as a supplement to it.

CONCLUSIONS

A sedentary lifestyle is widespread in the contemporary world, intensified by the prevalence of remote working and extended periods of sitting during leisure time. Numerous studies have shown that a sedentary lifestyle is associated with an increased risk of various diseases, including obesity, diabetes, and cardiovascular diseases. Due to the prevalence and increasing incidence of cancer in society, more attention is being given to the relationship between a sedentary lifestyle and the risk of cancer development. Research undeniably supports this correlation, but further studies are necessary to examine this phenomenon more precisely. It is also essential to increase the awareness of the public to this issue, and to implement preventive measures to reduce the risk of cancer. It is never too late to become more active and reduce a sedentary lifestyle to improve one's health [48].

Table 1. WHO Recommendations on Sedentary Behaviour [47]

Target group	Recommendations
Children and adolescents aged 5–17 years	Limit the amount of time spent in a sedentary lifestyle, particularly time spent in recreational screen viewing.
Adults aged 18–64 years	Limit the amount of time spent in a sedentary lifestyle. Replacing sedentary behaviour with physical activity of any intensity has health benefits. To reduce the harmful impact of a high level of sedentary behaviour on health, individuals should aim to engage in more than the recommended level of intense or moderate-intensity physical activity.
Older adults aged 65 years and over	Limit the amount of time spent in a sedentary lifestyle. Replacing sedentary behaviour with physical activity of any intensity has health benefits. To reduce the harmful impact of a high level of sedentary behaviour on health, individuals should aim to engage in more than the recommended level of intense or moderate-intensity physical activity.
Pregnant and postpartum	Limit the time spent in a sedentary lifestyle. Replacing sedentary behaviour with physical activity of any intensity has health benefits.
Children and adolescents aged 5–17 years and adults aged 18 years and older living with disability	Limit the amount of time spent in a sedentary lifestyle, particularly the time spent in recreational screen time.
Adults and older adults aged 18 years and older, with chronic conditions	Limit the amount of time spent in a sedentary lifestyle. Replacing sedentary behaviour with physical activity of any intensity has health benefits. To reduce the harmful impact of a high level of sedentary behaviour on health, individuals should aim to engage in more than the recommended level of intense or moderate-intensity physical activity.

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