JASIURA, Adam, LIPCZYŃSKA, Wiktoria, WARCHOŁ, Konrad and GORZEL, Mateusz. Access to public sports infrastructure in Poland as a preventive factor for cardiovascular diseases. Journal of Education, Health and Sport. 2023;21(1):115-122. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2023.21.01.012
https://apcz.umk.pl/JEHS/article/view/44849
https://zenodo.org/record/8169591

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 December 21, 2021. No. 32343.
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 21 grudnia 2021 r. Lp. 32343. 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).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 30.06.2023. Revised: 30.06.2023. Accepted: 20.07.2023. Published: 25.07.2023.

Access to public sports infrastructure in Poland as a preventive factor for cardiovascular diseases

Adam Jasiura[1]
https://orcid.org/0000-0002-4648-0981; adam.jasiura@student.umw.edu.pl
Wiktoria Lipczyńska[2]
https://orcid.org/0009-0001-9579-6173; wlipczynska@su.krakow.pl
Konrad Warchoł[3]
https://orcid.org/0000-0001-9467-680X; konrad.wrh@gmail.com
Mateusz Gorzel[4]
https://orcid.org/0000-0003-0506-0152; mateusz.gorzel@umw.edu.pl

1- Dolnośląskie Centrum Onkologii, Pulmonologii i Hematologii we Wrocławiu, Plac Ludwika Hirszfelda 12, 53-413 Wrocław
2- University Hospital in Krakow, Mikołaja Kopernika 36, 31-501 Kraków
3- Medical University of Lublin, Aleje Racławickie 1, 20-059 Lublin, Poland
4 - Uniwersytecki Szpital Kliniczny im. Jana Mikulicza-Radeckiego we Wrocławiu; ul. Borowska 213, 50-556 Wrocław

Abstract

Introduction: Cardiovascular diseases (CVDs) are a significant health concern globally, including in Poland. Physical activity has been identified as a crucial preventive factor for CVDs, and access to public sports infrastructure plays a vital role in promoting physical activity. However, the relationship between access to such infrastructure and its impact on cardiovascular health outcomes in Poland remains understudied.
Aim of the study: This study aims to investigate the impact of access to public sports infrastructure on the prevalence of cardiovascular diseases and mortality rates in Poland.
Materials and methods: Publicly available data were obtained regarding sports facilities, population structure, hospitalizations, and deaths.
Results: There is a moderate negative correlation ($r = -0.3096$; $p < 0.001$) between hospitalization rates for cardiovascular diseases and the stadiums and playing fields available in the studied countries. The correlation between cardiovascular hospitalizations and indoor and outdoor arenas and gyms was also negative, but its effect was moderately weak ($r = -0.2068$, $p < 0.001$; $r = -0.2597$, $p < 0.001$, respectively). The average hospitalization rate for cardiovascular diseases in subjects over 65 years of age ($M = 12117.24$) was significantly

higher compared to the group of all subjects (M = 3082.18) and subjects under 65 years of age (M = 1260.96). There is a negative correlation between the death rate and the availability of selected sports facilities, with a moderately weak effect for all sports infrastructure subgroups (r = -0.215 - -0.233).
Conclusion: The effect of accessibility to public sport infrastructure on CVDs prevalence and related deaths is moderate to weak. The studied positive effect particularly affects people under 65 years of age. Further studies of other sport-connected predictors may be beneficial.

Keywords: cardiovascular diseases, sport, prevention, public infrastructure.

Introduction

Cardiovascular diseases (CVDs) pose a significant and escalating health challenge worldwide, remaining the leading cause of death, growing from 12.1 million deaths in 1990 to 20.5 million deaths in 2021, with an estimation of 23.6 million in 2030 [1]. Poland is no exception to this pressing issue, CVDs comprise 34.8% of deaths in 2021 [2]. In recent years, preventive strategies targeting lifestyle modifications have gained prominence in reducing the burden of CVDs and reducing variable risk factors such as elevated blood pressure, dyslipidemia, or increased body weight [3].

Among these lifestyle factors, regular physical activity has been identified as a crucial preventive factor, contributing to improved cardiovascular health and reduced mortality rates [4]. In response to the increasing recognition of physical activity's benefits, numerous sports facilities, such as playing fields, arenas, and outdoor gyms, have been built across Poland to provide free and close-to-home opportunities for exercise.

However, a critical question arises - do these extensive investments in public sports infrastructure effectively contribute to the reduction of CVD-related mortality rates? In this research, we aim to investigate the impact of access to public sports infrastructure on the prevalence of cardiovascular diseases and mortality rates in Poland.

By examining the relationship between public sports infrastructure and its influence on cardiovascular health outcomes, this study seeks to provide valuable insights on whether an investment in this type of facilities is justified or whether funds for building public sports infrastructure could be better spent on other forms of prevention.

Materials and methods

Data

Data used in the study was from public sources available under a Creative Commons 4.0 license.

Data on selected sports facilities were obtained from the Polish Central Statistical Office's Local Data Bank (CSO-LDB). Near-school facilities were excluded from the study due to their limited availability to the studied population. Subgroups of stadiums and playing fields; arenas and gymnasiums; and outdoor gyms were selected. The most recent period available has been selected (2018).

Data regarding the population structure was provided by the CSO’s Local Data Bank, collected during the Polish National Census in 2021, taking into account changes due to natural movement, migration, and administrative relocation, considering changes due to

natural movement, migration, and administrative relocations. The most recent period available has been selected (31.12.2021).

Data regarding hospitalizations are from PROFIBAZA, collected by the National Institute of Public Health (NIH) - National Institute of Hygiene - National Research Institute (NIZP PZH - PIB). Age- and sex-standardized coefficients for the population were used. The most recent available period (2017–2019) has been selected.

Diagnoses of diseases for hospitalization rates were defined according to ICD-10. The following diseases subgroups were distinguished: cardiovascular diseases (I00-I99); hypertensive diseases (I10-I15); ischemic heart diseases (I20-I25); myocardial infarction (I21-I22); heart failure (I50); strokes (I61-I64); diseases of veins, lymphatic vessels, and lymph nodes (I80-I89).

This study used the administrative division of Poland as of 01.01.2023 according to the TERYT register. There were 380 county-level entries, of which 314 were counties (*powiaty*) and 66 were cities with county rights (*miasta na prawach powiatu*).

Methods

Coefficients were calculated for each county per 100,000 of its population. Two age subgroups – people up to 65 years of age, and people over 65 years of age – were distinguished for the selected diseases, for which Pearson correlation was significant in all the distinguished subgroups of sports facilities in the total studied sample. Analyses of the mean were conducted for the cumulative coefficients of cardiovascular diseases.

Statistical analysis

The Kolmogorov–Smirnov test was used to assess the normality of quantitative variables. Correlations were calculated using the r-Pearson coefficient. Then, for data sets between which a statistically significant correlation was determined, univariate linear regression models were created to assess the effect of the studied predictors. The calculated correlations were tested for significant differences using the Eid, Gollwitzer, and Schmidt method for independent samples [5] . Averages were compared between the studied groups using one-way ANOVA analysis with Tukey's post-hoc test. The significance level $\alpha = 0.05$ was chosen. The analyses were performed using TIBCO Statistica 13 package and MS Excel.

Results

In the analyzed periods, the mean hospitalization rate for cardiovascular diseases per 100,000 residents of the country was 3082.82. The most common distinguished causes of hospitalization in the selected county areas were heart failure (M = 718.31) and acute coronary incidents (M = 697.17). In contrast, the least common causes of hospitalization for cardiovascular diseases were vascular diseases (M = 201.18) and strokes (M = 217.07).

Correlations

A moderate negative correlation ($r = -0.3096$; $p < 0.001$) was observed between the hospitalization rates for cardiovascular diseases and the stadiums and playing fields available in the studied counties. The relationships between cardiovascular hospitalizations and arenas and gymnasiums as well as outdoor gyms were also negative, but the effect was moderately weak (respectively, $r = -0.2068$, $p < 0.001$; $r = -0.2597$, $p < 0.001$). A similar negative correlation with a moderately weak effect was also described for all sports infrastructure elements studied for hospitalizations for hypertension and heart failure, while no statistically

significant correlation was shown for the other selected causes of hospitalization in at least one of the distinguished infrastructure subgroups. Summarized Pearson correlation coefficient results are presented in Table 1.

Table 1. Correlations between hospitalization rates and accessibility to selected elements of public sports infrastructure.

	M	SD	Stadiums and playing fields		Arenas and gymnasiums		Outdoor gyms	
			r	p	r	p	r	p
Total cardiovascular diseases	3082,18	856,789	**-0,3096**	**0,000**	**-0,2068**	**0,000**	**-0,2597**	**0,000**
Ischemic heart diseases	206,89	148,401	**-0,1811**	**0,000**	**-0,102**	**0,047**	-0,0787	0,126
Myocardial infarction	697,17	219,886	-0,0318	0,536	-0,0269	0,601	-0,0246	0,632
Strokes	217,07	71,832	**-0,1455**	**0,004**	-0,0707	0,169	**-0,1384**	**0,007**
Hypertensive diseases	233,36	60,632	**-0,2375**	**0,000**	**-0,1299**	**0,011**	**-0,2057**	**0,000**
Heart failure	718,31	330,591	**-0,2211**	**0,000**	**-0,2291**	**0,000**	**-0,2449**	**0,000**
Diseases of veins, lymphatic vessels, and lymph nodes	201,18	65,037	-0,0825	0,108	-0,0457	0,374	-0,0292	0,570

Two age subgroups were distinguished, people up to age 65 and people over age 65, for the disease units for which correlation was shown in all the selected subgroups of sports infrastructure in the sample. The average hospitalization rate for all cardiovascular diseases in people over 65 years of age per 100,000 residents of the studied counties was 12117.24, for hypertension it was 613.57, and for heart failure it was 3082.18. There is a negative correlation between the hospitalization rate for all cardiovascular diseases and the availability of selected elements of sports infrastructure, with a moderately weak effect for all groups of sports facilities. In hospitalizations due to cardiovascular diseases, a moderate negative correlation was described with the number of available stadiums and playing fields in the studied counties ($r = -0.3017$, $p < 0.001$). A moderately weak negative effect was shown for the other correlations described. The Pearson correlations for the subgroup of people over 65 are shown in Table 2.

Table 2. Correlations between the hospitalization rates for selected cardiovascular diseases and accessibility to selected elements of public sports infrastructure in the subgroup of people over 65 years of age.

	M	SD	Stadiums and playing fields		Arenas and gymnasiums		Outdoor gyms	
			r	p	r	p	r	p
Total cardiovascular diseases	12117,24	3373,754	**-0,1994**	**0,000**	**-0,2234**	**0,000**	**-0,1949**	**0,000**
Hypertensive diseases	613,57	515,124	**-0,1804**	**0,000**	**-0,1053**	**0,040**	**-0,1701**	**0,001**
Heart failure	3082,18	856,789	**-0,3017**	**0,000**	**-0,2024**	**0,000**	**-0,2585**	**0,000**

The mean hospitalization rate for all cardiovascular diseases in people under 65 years of age per 100,000 residents of the studied counties was 1260.96, for hypertension, it was 124.74, and for heart failure, it was 144.21. There is a negative correlation between the hospitalization rate for all cardiovascular diseases and the accessibility of selected elements of

sports facilities, with a moderately weak effect for all groups of sports facilities for all the distinguished diseases. The Pearson correlations for the subgroup of people over 65 are shown in Table 3.

Table 3. Correlations between the hospitalization rates for selected cardiovascular diseases and accessibility to selected elements of public sports infrastructure in the subgroup of people under 65 years of age.

	M	SD	Stadiums and playing fields		Arenas and gymnasiums		Outdoor gyms	
			r	p	r	p	r	p
Total cardiovascular diseases	1260,96	306,282	**-0,2858**	**0,000**	**-0,1964**	**0,000**	**-0,2031**	**0,000**
Hypertensive diseases	124,74	78,915	**-0,2382**	**0,000**	**-0,1587**	**0,002**	**-0,1908**	**0,000**
Heart failure	144,21	56,937	**-0,2136**	**0,000**	**-0,1907**	**0,000**	**-0,2249**	**0,000**

Comparisons of the mean and correlation between selected groups

In order to assess the differences between the mean rates of hospitalization for all cardiovascular diseases in the distinguished age subgroups, an ANOVA analysis was performed. The means in the compared groups are significantly different from each other ($F_{Welch's}$ (2, 2637.65); $p < 0.001$; $\eta_p^2 = 84.74\%$). The observed effect has very high statistical power, explaining 84.74% of the total variation in the measured test score. Subsequently, the Tukey post-hoc test was performed, which showed the significance of differences between all age subgroups studied ($p < 0.001$). The mean hospitalization rate for cardiovascular diseases in subjects over 65 years of age (M = 12117.24) was significantly higher compared to the group of all subjects (M = 3082.18) and subjects under 65 years of age (M = 1260.96).

For the correlation coefficients between the hospitalization rates for all cardiovascular diseases and the accessibility of stadiums and playing fields, a z statistic was calculated according to the method proposed by Eid, Gollwitzer, and Schmidt [5] . The differences between these correlations are at the border of statistical significance ($z = -1.62$, $p = 0.53$).

Linear regression model

For comparisons in which the Pearson correlation coefficient value was the highest, a linear regression model of the hospitalization rate for all cardiovascular diseases was constructed. The number of stadiums and playing fields per 100 000 residents available in the counties was chosen as the independent variable. The average difference between actual values and those predicted by the model for the dependent variable was 815.75 (representing 26.5% of the mean for the dependent variable). Despite the low value of the coefficient of determination in the model ($R^2 = 9.58$), the value of the F statistics (40.07) and the corresponding p level ($p < 0.001$) indicate the statistical significance of the model. These values can be interpreted as meaning that the construction of one stadium or playing field per 100,000 county residents will result in a reduction of 168.99 per 100,000 population in the incidence of hospitalization for cardiovascular diseases in the studied area.

Deaths

The average death rate due to cardiovascular diseases per 100,000 residents of the surveyed counties was 500.02. There is a negative correlation between death rates and the availability of selected sports facilities, with a moderately weak effect for all groups of sports

infrastructure. For arenas and gymnasiums, the largest effect of the selected subgroups studied was described (r = 0.2325), while for stadiums and playing fields, the effect was the weakest (r = -0.167). The Pearson correlation results for cardiovascular deaths are presented in Table 4.

Table 4. Correlations between the frequency of death and accessibility to selected elements of public sports infrastructure.

	M	SD	Stadiums and playing fields		Arenas and gymnasiums		Outdoor gyms	
			r	p	r	p	r	p
Deaths	500,02	125,508	**-0,167**	**0,001**	**-0,2325**	**0,000**	**-0,2148**	**0,000**

Discussion

The health-promoting effects of physical activity have been known for many years. Our statistical analysis showed that the amount of sports infrastructure is inversely proportional to the number of hospitalizations for cardiovascular diseases, particularly hypertension and heart failure. We further analyzed the impact of different types of sports infrastructure on these three groups of diseases and divided the study group into those under and over 65 years old.

In the 65+ group, we showed that the number of stadiums and sports fields in the study counties had the greatest impact on the decrease in hospitalizations for cardiovascular diseases. The rest of the infrastructure also affected the decrease, but at a lower level. The positive impact of physical activity not only on reducing cardiovascular incidents but also on improving quality of life in this age group has been proven by other researchers. They have written about the effects of moderate exercise, mainly aerobic, on the overall well-being of older people. Half-hour walks five times a week are most recommended [4,6].

For people under 65, each of the sports components had a moderately weak effect on the number of hospitalizations for cardiovascular disease. However, physical activity is known to have a positive effect on the prevention of cardiovascular disease in any age group [7].

The difference between the number of hospitalizations for cardiovascular diseases between selected age groups is statistically significant. Based on the calculated statistics, we can say that the construction of one stadium or sports field per 100,000 residents of the county will reduce the incidence of hospitalization for cardiovascular diseases in the area by 168.99 per 100,000 residents.

If we consider the impact of sports infrastructure on deaths from cardiovascular disease, it has a moderately low impact on the number of deaths. Of the investigated categories, arenas and gymnasiums have the greatest impact on reducing deaths, while stadiums and playing fields have the least impact.

The under-65 subgroup is the one that uses the facilities included in our study most often, and perhaps that's why the correlations in this group are most valuable. The elderly may not have been the target of the facilities we selected for the study, hence the impact was less outlined. This group is more likely to participate in activities organized at a community center or retirement home. Perhaps we would have a more significant impact as a society by investing in other preventive programs or by building centers with more elderly-friendly infrastructure. Creating not only infrastructure but also an environment full of greenery that is pleasant to socialize in and organizing cultural events, i.e. concerts or vernissages, increases life satisfaction and physical activity among seniors [8].

We have shown that increasing the number of sports facilities significantly reduces the number of cardiovascular incidents, which demonstrates their relevance in preventing their occurrence. Jeong et al. prove in their study that people with cardiovascular disease who maintain a high level of physical activity are able to live longer than people without cardiovascular disease who do not maintain physical activity at all [9], thereby showing that it is worth investing in places that increase physical activity for people of any age.

It would be worthwhile to do a similar analysis of the latest data after its publication by the CSO and compare the results with those obtained by us. Society has changed a lot since the outbreak of the COVID-19 pandemic, and the data may be quite different if only due to the lockdown and reduction in the amount of time spent on these facilities. The change in attitudes towards physical activity during the pandemic was described by Jauregui et al. In their paper "Scaling up urban infrastructure for physical activity in the COVID-19 pandemic and beyond" they highlighted the tendency of people to shift to safer modes of transportation at the time, such as bicycles, in order to avoid public transportation and thus expose themselves to SARS-CoV-2 virus infection [10].

Supplementary Materials

The following supporting information can be downloaded at:
https://drive.google.com/drive/folders/1P4mf5tMvp1cWDXzfmp6LoOQ4IM2Hk0Ib?usp=sharing

Table 1. Correlations between hospitalization rates and accessibility to selected elements of public sports infrastructure.

Table 2. Correlations between the hospitalization rates for selected cardiovascular diseases and accessibility to selected elements of public sports infrastructure in the subgroup of people over 65 years of age.

Table 3. Correlations between the hospitalization rates for selected cardiovascular diseases and accessibility to selected elements of public sports infrastructure in the subgroup of people under 65 years of age.

Table 4. Correlations between the frequency of death and accessibility to selected elements of public sports infrastructure.

Author Contributions

Conceptualization, A.J.; writing—original draft preparation, A.J., W.L., K.W. M.G.; writing—review and editing A.J., K.W.; project administration, A.J.

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

Funding

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Publicly available datasets were analyzed in this study. This data can be found here: (https://eteryt.stat.gov.pl/eTeryt/rejestr_teryt/udostepnianie_danych/baza_teryt/baza_teryt.aspx?contrast=default/ (accessed on 20 July 2023)), (https://stat.gov.pl/en/topics/culture-tourism-sport/sport/physical-education-in-poland-in-2022,3,6.html ((accessed on 20 July 2023)), (https://stat.gov.pl/spisy-powszechne/nsp-2021/nsp-2021-wyniki-ostateczne/ ((accessed on 20 July 2023)), (https://profibaza.pzh.gov.pl/wskazniki-zdrowotne ((accessed on 20 July 2023))

Acknowledgments
Not applicable
Conflicts of Interest
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Bibliography

[1] "Deaths from cardiovascular disease surged 60% globally over the last 30 years: Report - World Heart Federation." https://world-heart-federation.org/news/deaths-from-cardiovascular-disease-surged-60-globally-over-the-last-30-years-report/ (accessed Jun. 12, 2023).

[2] "Raport: Sytuacja zdrowotna ludności Polski i jej uwarunkowania - NIZP PZH - PIB." https://www.pzh.gov.pl/raport-sytuacja-zdrowotna-ludnosci-polski-i-jej-uwarunkowania/ (accessed Jun. 12, 2023).

[3] S. Francula-Zaninovic and I. A. Nola, "Management of Measurable Variable Cardiovascular Disease' Risk Factors," *Curr Cardiol Rev*, vol. 14, no. 3, pp. 153–163, Feb. 2018, doi: 10.2174/1573403X14666180222102312.

[4] L. Ciumărnean *et al.*, "Cardiovascular Risk Factors and Physical Activity for the Prevention of Cardiovascular Diseases in the Elderly," *Int J Environ Res Public Health*, vol. 19, no. 1, p. 207, Jan. 2022, doi: 10.3390/IJERPH19010207.

[5] M. Eid, M. Gollwitzer, and M. Schmitt, "Statistik und Forschungsmethoden," p. 1088, 2017, Accessed: Jun. 16, 2023. [Online]. Available: https://sfbs.tu-dortmund.de/handle/sfbs/3110

[6] B. Langhammer, A. Bergland, and E. Rydwik, "The Importance of Physical Activity Exercise among Older People," *Biomed Res Int*, vol. 2018, 2018, doi: 10.1155/2018/7856823.

[7] D. E. R. Warburton, "Health benefits of physical activity: the evidence," *Canadian Medical Association Journal*, vol. 174, no. 6, pp. 801–809, Mar. 2006, doi: 10.1503/cmaj.051351.

[8] J. Jiang, Z. Xia, X. Sun, X. Wang, and S. Luo, "Social Infrastructure and Street Networks as Critical Infrastructure for Aging Friendly Community Design: Mediating the Effect of Physical Activity," *International Journal of Environmental Research and Public Health*, vol. 19, no. 19, p. 11842, Sep. 2022, doi: 10.3390/ijerph191911842.

[9] S.-W. Jeong *et al.*, "Mortality reduction with physical activity in patients with and without cardiovascular disease," *European Heart Journal*, vol. 40, no. 43, pp. 3547–3555, Nov. 2019, doi: 10.1093/eurheartj/ehz564.

[10] A. Jáuregui, E. V. Lambert, J. Panter, C. Moore, and D. Salvo, "Scaling up urban infrastructure for physical activity in the COVID-19 pandemic and beyond," *The Lancet*, vol. 398, no. 10298, pp. 370–372, Jul. 2021, doi: 10.1016/S0140-6736(21)01599-3.