
THE INFLUENCE OF PUBLIC EXPENDITURE ON SPORTS SERVICES AND GOODS ON PRIVATE CONSUMPTION AND SEDENTARY BEHAVIOUR IN EUROPEAN COUNTRIES

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Abstract:

The objectives of this study were (i) to examine the influence of public expenditure on sports services and goods on private consumption and (ii) to assess whether the prevalence of sedentary behaviour could be predicted by public expenditure in sports, taking into account educational level, and sex differences in European countries. Data from 27 European countries were used; one additional country was included for objective (i) (n=29) and three for objective (ii) (n=30). A Pearson bivariate correlation and a distributed lag model were used to examine the relationship between public expenditure and private consumption, with GDP per capita included as a control variable. Additionally, multiple linear regression models were applied to predict sedentary behaviour based on GDP, educational level, and sex. Results showed a strong positive correlation between public expenditure and private consumption ($r=0.846-0.922$, $p<0.001$). The lagged model, including public expenditure over five years and GDP per capita, explained more than 75% of the variance in private sports consumption. GDP per capita predicted sedentary behaviour in over 44.3% of cases across medium, high, and total education groups. Public expenditure was also a significant predictor in selected subgroups, particularly in the total education group and among women.

Key words: *Physical activity, exercise, GDP, education level, distributed lag model*

1. Introduction

In recent decades, the promotion of physical activity and sport has increasingly been framed not only as a public health priority but also as an economic issue. Across Europe, rising levels of sedentary behaviour are contributing to higher healthcare expenditures, productivity losses, and long-term fiscal pressures. As a result, governments

are progressively viewing investments in sport and physical activity not merely as social or health interventions, but as strategic economic tools aimed at reducing future costs and enhancing human capital. Within this context, understanding the economic mechanisms that shape participation in sport-related activities becomes particularly relevant.

From an economic perspective, sport represents a hybrid sector in which public and private dynamics are closely intertwined. Governments allocate resources to sport infrastructure, programs, and services, while households respond through their consumption of sport-related goods and services, such as equipment, memberships, or participation fees. This interaction reflects a broader economic question: to what extent can public expenditure stimulate private consumption? The literature in other sectors, such as education and healthcare, suggests that public investment can generate complementary private spending through “crowd-in” effects. However, whether this mechanism operates similarly in the sport sector remains insufficiently explored, particularly in a cross-country European context. At the same time, macroeconomic conditions play a central role in shaping both public investment capacity and private consumption behaviour. Gross domestic product (GDP) per capita, as a proxy for national wealth and individual purchasing power, is likely to influence not only the level of public spending but also households’ ability to engage in sport-related consumption. In this sense, failing to account for economic development may lead to misleading conclusions about the effectiveness of public policies. Indeed, higher levels of income are consistently associated with greater participation in leisure, sport, and recreational activities, suggesting that economic factors may outweigh policy interventions in determining behavioural outcomes. Sedentary behaviour further illustrates the intersection between economics and public health. While it is often addressed as a lifestyle issue, it is also deeply embedded in socioeconomic structures. Educational level, income, and labour conditions all influence the likelihood of engaging in physical activity and sport. Individuals with higher socioeconomic status tend to have greater access to resources, information, and environments that facilitate active lifestyles, whereas disadvantaged groups may face structural barriers that limit participation regardless of public provision. Consequently, the economic environment may not only shape consumption patterns but also determine the extent to which public expenditure translates into actual behavioural change. Despite the growing recognition of these dynamics, there remains a limited understanding of how public expenditure in sport interacts with broader economic variables to influence both private consumption and sedentary behaviour across European countries. Most existing studies have focused either on micro-level determinants of sport participation or on the health outcomes of physical activity, leaving a gap in macroeconomic analyses that integrate both dimensions over time.

2. Literature review

From the classical point of view, physical activity (PA) is any bodily movement that increases energy expenditure above resting levels, whereas physical exercise (or just exercise) is a planned, structured form of PA primarily intended to improve physical fitness (Caspersen *et al.*, 1985). Accordingly, both PA and exercise are associated with a broad

spectrum of health benefits, such as reducing the risk of chronic diseases (Papa *et al.*, 2021), improving mental health (Yao *et al.*, 2021), and enhancing quality of life (Warburton & Bredin, 2017). It has been shown that they reduce the risk of cardiovascular diseases (Enguita-Germán *et al.*, 2021), type 2 diabetes (Dhuli *et al.*, 2022), and certain types of cancer (Dinas *et al.*, 2024), making them a cornerstone of preventive medicine (Thompson *et al.*, 2020). Additionally, PA and exercise help alleviate symptoms of depression and anxiety by releasing endorphins, which act as natural mood enhancers (Smith and Merwin, 2020). If we understand sport as a part of physical activity, it has been shown that there is a positive correlation between sports participation and reported life satisfaction (Frey *et al.*, 2021). Within this broader framework, sport can be understood as a specific institutionalized and socially organized form of physical activity that often requires infrastructure, equipment, and services. Because of this institutional dimension, sport is particularly relevant when analyzing the relationship between public expenditure and private consumption, as governments frequently invest directly in sport-related infrastructure, programs, and services. Participation in sport-related activities also contributes to preserving mobility, balance, and independence, benefits that are especially important in older adults. Specific exercise programs have been shown to improve motor skills and significantly prevent falls and related injuries (Božić & Zelenović, 2022). A concept closely related to PA and exercise is sedentary behaviour, which is defined as any waking behaviour characterized by an energy expenditure of ≤ 1.5 metabolic equivalents (METs) while in a sitting, reclining, or lying posture (Fanchamps *et al.*, 2017). This definition has been widely adopted by the research community, as it captures both the low-energy aspect and the specific postures associated with sedentary behaviour (Pinto *et al.*, 2023). Sedentary behaviours pose a critical public health challenge in Europe, with approximately 30% of the population exhibiting high levels of sedentary behaviour and nearly 40% failing to meet the minimum PA recommendations (Eurostat, n.d.). Different aspects influence sedentary behaviour. For example, research has shown that higher levels of education are associated with lower prevalence of sedentary behaviour, as individuals with stronger educational backgrounds tend to adopt more active lifestyles (Carpenter *et al.*, 2021). Also, sedentary time has been found to increase with age, which elevates the risk of developing metabolic syndrome and other health conditions (Bankoski *et al.*, 2011). In addition, recent study highlight that motivational factors such as personal habits and lifestyle choices and socioeconomic inequalities such as family socioeconomic status, play a significant role in shaping PA habits (Melguizo-Ibáñez *et al.*, 2023).

In Europe, investing in PA and exercise is increasingly recognized as a strategic approach to reduce the economic burden of chronic diseases. For example, the report “Step Up! Tackling the Burden of Insufficient Physical Activity in Europe” (OECD/WHO, 2023) clearly demonstrates that raising PA levels can extend life expectancy by up to 7.5 months among insufficiently active individuals, prevent more than 10,000 premature deaths each year, and save EU Member States as much as EUR 8 billion in purchasing power parity yearly. In this way, governments protect the health of citizens through various actions reflected in their budgets (Frieden, 2013), including the promotion of PA and exercise as a preventive measure against chronic diseases (Carvalho *et al.*, 2024; Karvinen *et al.*, 2012). Recent research highlights that sedentary behaviour imposes a

significant financial burden on healthcare systems with estimates suggesting potential savings of several billion euros annually through effective strategies promoting PA (Racine *et al.*, 2022). Braun *et al.* (2022), who did a systematic review found evidence of substantial savings, particularly in European countries where tailored programs were implemented. Similarly, the Policy Evaluation Network emphasizes the need for comprehensive policy interventions, as these not only improve public health but also reduce economic disparities by addressing the "root causes" of physical inactivity (Ahrens *et al.*, 2022). Furthermore, investing in PA can contribute to long-term GDP growth by lowering rates of premature mortality and morbidity. In this way, a study conducted by Hafner *et al.* (2020) estimated that achieving compliance with WHO physical activity guidelines could raise GDP by up to 0.24% annually through 2050, yielding cumulative global gains amounting to trillions of dollars. There is also recent evidence that highlights how sport policies can influence physical activity, although the policies' impact varies depending on context and policy design (Volf *et al.*, 2022). In addition to public expenditure, private consumption must also be considered. Asimakopoulos *et al.* (2021) argue that the latter could increase, in the short run and long run, if there is an increase in the productive component of public spending).

This dynamic between public and private spending can also be observed across various sectors, illustrating the broader mechanism through which government investment stimulates complementary private consumption. For instance, in the education sector, public spending plays a crucial role in improving the accessibility and quality of basic services, while also encouraging private investment in specialized educational programs and advanced training. A recent study demonstrated that in wealthy families, public spending on education has a "crowd-in" effect, meaning these families tend to increase their private investment in their children's education, complementing public resources. In contrast, in low-income families, public spending has a "crowd-out" effect, as they tend to reduce their private educational spending and prioritize personal consumption and well-being (Yu & Zhao, 2021). Similar patterns emerge in other key public sectors, where strategic government investment not only improves service delivery but also acts as a catalyst for increased private sector participation. In this way, public consumption has a direct effect on promoting complementary private investments. Thus, expenditures on infrastructure, such as the construction of roads, ports, and transport networks not only improve connectivity and reduce operational costs but also attract private sector investments in related areas, such as transportation and logistics. Recent research found that these expenditures are essential to stimulating commercial activity and technological modernization in the private sector (OECD, 2010). In the health sector, an increase in public spending establishes a solid foundation for improving healthcare infrastructure, generating trust in the system, and motivating households and businesses to invest in complementary services such as health insurance and advanced diagnostic technologies. Studies have pointed out that these investments not only improve health outcomes but also enhance private consumption on related services, contributing to an integrated and sustainable healthcare system (Morgon, 2015). In the sports sector, Dallmeyer *et al.* (2020) found that public expenditure on sports and physical activity (including spending that encourages gym memberships and the purchase of sports equipment) is significantly

associated with increased private participation in sports and plays a key role in promoting public health. Furthermore, there is research suggesting that public expenditure on sports not only activates private consumption in the sports sector, driving sustainable development and community well-being, but also enhances quality of life and access to physical activities (Wang *et al.*, 2022).

Despite the growing body of evidence on the health and economic benefits of PA, European countries continue to face high levels of physical inactivity and sedentary behaviour, which generate significant public health costs and deepen socioeconomic inequalities. Yet, there is limited research exploring how public expenditure in the sports sector influences private consumption patterns across European countries. While the effectiveness of government investment in infrastructure, health, and education has been well documented (Morgon, 2015; Yu & Zhao, 2021), its potential to stimulate private spending and behavioral engagement in sports remains underexplored—particularly through multi-year, cross-national analyses. In this line, several authors note that major economic fluctuations, such as global recessions, have uneven effects across the sports system, with elite and mega-event sectors remaining relatively resilient while grassroots sports suffer the most due to reduced household resources, declining volunteer participation, and a contraction of both public and private funding (Földesi, 2014). If this knowledge gap persists, public policy may continue to overlook an important lever for reducing sedentary behaviour and promoting active lifestyles.

Although previous studies have analyzed the determinants of sport participation or the health effects of physical activity, comparatively fewer investigations have examined the macroeconomic relationship between public sport expenditure and private sport consumption across multiple countries and over time. This gap is particularly relevant because national policies may influence sport participation not only through direct public programs but also indirectly through economic incentives that shape household spending behavior. Against this background, and building on the need to better understand how public investment can shape private behavior, the objectives of this study are: (i) to examine the influence of public expenditure on sports services and goods on private consumption and (ii) to assess whether the prevalence of sedentary behaviour could be predicted by public expenditure in sports, taking into educational level, and sex differences in European countries.

3. Methodology

3.1. Type of study

This quantitative observational study analyzed numerical data from official public sources without manipulating variables; it was retrospective and longitudinal (2006–2020) and incorporated both a longitudinal panel component and a cross-sectional analytical component. The longitudinal component covered the period 2006–2020 and was used to examine the temporal relationship between public expenditure and private household consumption in sport-related goods and services. The cross-sectional component relied on the most recent harmonized dataset available on sedentary behaviour across European countries, corresponding to the year 2019. For the first objective of the study, the independent variable was public expenditure on sports-related goods and services, the

dependent variable was private household consumption expenditure on sport-related goods and services, and the control variable is GDP per capita. Whereas for the second objective, the dependent variable was the prevalence of sedentary behaviour (i.e., the percentage of the population not engaging in regular PA), while the independent variable was government expenditure on sports-related goods and services. Moreover, two control variables were included: GDP per capita to account for the wealth and median age as a demographic confounder potentially related to PA patterns. The study also included two grouping variables: sex and educational level. This research design followed the recommendations of research textbooks such Creswell and Creswell (2018) and Gujarati and Porter (2009).

3.2. Country selection

The sample countries included in this study were the European countries for which complete data was available regarding public expenditure on sports-related goods and services, private household consumption on sport-related goods and services, and GDP per capita. A total of 27 countries were included in both objectives: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden. In addition, Finland was included only for objective (i), while Iceland, Serbia, and Türkiye were included only for objective (ii). The sample countries included in this study were the European countries for which complete data was available regarding public expenditure on sports-related goods and services, private household consumption on sport-related goods and services, and GDP per capita. Public expenditure data covered the period from 2006 to 2020. Private household consumption data were available for three benchmark years (2010, 2015, and 2020). These data points correspond to the only harmonized observations reported across all countries in the Eurostat database. Consequently, the analysis of private consumption was based on repeated observations at five year intervals rather than a fully balanced annual panel. The unit of analysis in the longitudinal component was the country-year observation. For the analysis of sedentary behaviour, the unit of analysis was country × sex × education level.

3.3. Databases and data

The relevant data for the study came from the Eurostat database (n.d.). It contains data on population, GDP per capita, public expenditure on sports-related goods and services, and private household consumption of sport-related goods and services. This database was selected because it offered the specific economic and demographic variables necessary to address the objectives of the study. Data on public expenditure from 2006 to 2020 in sporting goods and services, private household consumption expenditure (for the years 2010, 2015, and 2020), population figures, and GDP per capita. With regard to sport-related goods and services, those identified are considered to be fully sport-specific or related to sport activities (Eurostat, COICOP, n.d.), and are grouped into five categories: (1) Major durables for outdoor recreation: camper vans, caravans and trailers, etc; (2) Major durables for indoor recreation: billiard tables, ping-pong tables, pin-

ball machines, gaming machines, etc.; (3) Maintenance and repair of other major durables for recreation and culture: laying up for winter of boats, camper vans, caravans, etc.; (4) Equipment for sport, camping and open-air recreation: e.g. gymnastic, physical education and sport equipment, etc.; (5) Recreational and sporting services: services provided by sports stadiums, horse-racing courses, motor-racing circuits, velodromes, etc. for the attendance of a sportive or recreational event; fairgrounds and amusement parks; playground facilities for children etc. This last category includes a sub-classification that was used in the analysis: attendance and participation in recreational and sporting services. Attendance refers to the expenditure made to passively use a recreational or sporting service, for example, attending a football match as a spectator. Participation, on the other hand, refers to the expenditure associated with actively engaging in a recreational or sporting activity, for instance, renting a football pitch to play or regularly attending football training sessions.

In the same line the prevalence of sedentary behaviour was obtained from Sport participation – practicing sport and physical activity, Statistics Explained (Eurostat Sport, n.d.). This database provides country-level information on PA among individuals aged 18 and over, divided into three main categories: walking and cycling (excluding commuting to work or between activities), aerobic activities, and strength activities (excluding occupational PA in both cases). The database also reports the percentage of time dedicated to each activity group. In this context, sedentary behaviour was defined as engaging in zero minutes of activity across the three groups combined. Similarly, this database reports educational level according to the International Standard Classification of Education (UNESCO Institute for Statistics, 2012). It is grouped into three main categories: low level: Less than primary, primary, and lower secondary education (ISCED levels 1–2); medium level: Upper secondary and post-secondary non-tertiary education (ISCED levels 3–4), high level: Tertiary education (ISCED levels 5–8). For each country, then, there are a total of 12 observations, stemming from the combination of four possible education levels (total, low, medium and high) and three possible sex values (total, male and female). The age (median) variable was obtained from Eurostat (Eurostat Population, n.d.).

Finally, public expenditure on sports-related goods and services, measured in euros per inhabitant (total spending divided by population), which includes government budget allocations directed towards sport and recreational activities; private household consumption on sport-related goods and services, measured in per capita spending by country in euros; and GDP per capita, measured in euros as a general economic reference for each country.

3.4. Procedures

Data were extracted for public expenditure on sports-related goods and services (2006–2020), private household consumption of sport-related goods and services (2010, 2015, and 2020), GDP per capita, and population. The dataset was cleaned and organized, and countries with incomplete data were excluded from the analysis. Specifically, countries were excluded if key variables were missing for the benchmark years required in the analysis. Missing observations were inspected before analysis, and countries that did not report complete information for the relevant variables were removed

in order to maintain comparability across observations. Public expenditure per capita was calculated by dividing total public spending by the population of each country.

3.5. Statistical analysis

To examine the relationship between private and public consumption in sport-related goods and services, a bivariate Pearson correlation was conducted for the three years in which private consumption data were available: 2010, 2015, and 2020. The bivariate correlation was performed using log-transformed data, as this approach allows for the analysis of proportional relationships in datasets where the variables do not scale linearly, but exponentially and helps stabilize variance, making the linear association between variables more reliable (Gao *et al.*, 2020; Gujarati & Porter, 2009). It should be noted that the Pearson correlation coefficient measures the strength and direction of the linear association between two variables but does not imply causality or represent the magnitude of percentage changes between them.

Following the correlation analysis, a predictive model was developed to assess the extent to which public expenditure on sports-related goods and services could explain variations in private household consumption, a distributed lag model (Creswell & Creswell, 2018; Gujarati & Porter, 2009) was employed to account for the potential delayed effects of public spending on private behavior over time. This type of analysis was employed in past research and is well founded. For example, Auerbach *et al.* (2022) used in their study distributed lag models to examine the delayed effects of fiscal policy, specifically government spending, on macroeconomic outcomes during economic downturns, using instrumental variable techniques. While Hadianfar *et al.* (2023) applied a similar methodological framework to quantify the time-delayed impact of COVID-19 cases on mortality rates across European countries.

The model proposed in this study included the current year's public expenditure as well as the four preceding years (t , $t-1$, $t-2$, $t-3$, and $t-4$) to capture both immediate and delayed effects of government spending. The inclusion of four lagged terms was chosen to reflect the temporal spacing of the available household consumption data and to explore whether public investment in sport-related services may influence private consumption with a time delay. The equation for the model was structured as follows:

$$Y_t = \alpha + \beta_1 X_t + \beta_2 X_{t-1} + \beta_3 X_{t-2} + \beta_4 X_{t-3} + \beta_5 X_{t-4} + \gamma_1 Z_t + \epsilon_t$$

where Y_t represents private consumption per capita, X_t to X_{t-4} denote public expenditure per capita in the current and four previous years, and Z_t represents GDP per capita.

For each benchmark year in which private consumption data were available (2010, 2015, and 2020), the lagged public expenditure variables correspond to the annual values of the current year and the four preceding years. For example, for the 2010 observation, the model includes public expenditure values for 2010 (t), 2009 ($t-1$), 2008 ($t-2$), 2007 ($t-3$), and 2006 ($t-4$).

To consider if there is a possible issue of autocorrelation of the residuals in the model, a Durbin-Watson test was employed on the unweighted model. To test if there were

possible issues of multicollinearity a Variance Inflation Factor (VIF) test was used. These diagnostic tests were conducted to verify key assumptions of the regression model, including the independence of residuals and the absence of excessive collinearity among explanatory variables.

Regarding the multiple linear regression, this analysis examined the prevalence of sedentary behaviour based on public expenditure on sports-related goods and services, GDP per capita, and age. This type of analysis has also been previously applied in related research and is supported by existing literature. For example, the study by Shapiro *et al.* (2012) used multiple linear regression models to analyze the relationship between the pricing of luxury suites in North American sports venues and various explanatory variables of demographic, economic, and team- or league-specific nature. Similarly, Oga (1998) applied multiple linear regression analysis to investigate how fluctuations in the national economy affect the value of the sports industry in Japan.

To improve linearity, reduce skewness, and stabilize variance, a logarithmic transformation was applied to all independent variables (Creswell & Creswell, 2018; Gujarati & Porter, 2009). The analysis was stratified by sex (total population, men, and women) and by educational level (low, medium, and high) according to the ISCED 2011 classification, allowing for comparisons across different population subgroups. This method enabled the estimation of how each predictor contributed to variations in sedentary behaviour while controlling for the influence of the others, thus offering a more nuanced understanding of the social and economic factors associated with physical inactivity in European countries.

For the analysis, the R software package (readxl, dplyr, ggplot2, purrr, stats, tidyr, writexl) was used, setting the $p\text{-value} < 0.05$ to consider the relationship as significant.

4. Results/findings

Table 1 shows the Pearson correlation coefficients for the years 2010, 2015, and 2020 between total public expenditure and (i) total private consumption on sports-related goods and services; (ii) total private consumption on attending sporting or recreational events plus participation in sports activities; (iii) total private consumption on sporting goods and attendance at sporting or recreational events and (iv) total private consumption on participation in sports activities. The Pearson correlation coefficients (r) are reported, with values reaching up to 0.842 ($p < 0.001$). These coefficients indicate a strong positive linear association between public expenditure and private consumption in several categories. The association between total public expenditure and total private consumption on sports-related goods and services strengthens over the years, while the association for attendance at sporting or recreational events plus participation declines. As the explanatory relationship between total public expenditure and total private consumption on attendance at sporting or recreational events increases, private consumption on participation in sports activities decreases, and vice versa. By way of explanation of what the table implies, for example, in the year 2020, the correlation coefficient between total public expenditure and total private consumption reached $r = 0.922$ ($p < 0.001$), indicating a strong positive association between the two variables.

Table 1. Pearson correlation coefficients are showed between total public expenditure and total private consumption in its different categories. In all cases $p < 0.001$

	Total public expenditure		
	2010	2015	2020
Total private consumption			
On sports-related goods and services	0.882	0.886	0.922
On attendance at sporting or recreational events plus participation	0.934	0.898	0.896
On attendance at sporting or recreational		0.890	0.846
On participation in sport activities		0.866	0.879

Note: In 2010, Eurostat published these data: *On attendance at sporting or recreational* and *On participation in sport activities*, jointly, without differentiation.

Table 2 shows that private household consumption (C1–4) was predicted above 75% in all cases based on public expenditure on sports-related goods and services (G) in the previous four years (t) and GDP per capita. The two highest predicted consumption categories were attendance at sporting or recreational events plus participation in sports activities (86.1%) and sporting goods and services (81.6%). However, it should be taken into account that the high overall model fit is mainly attributable to GDP per capita, while the incremental predictive value of the lagged public expenditure terms is limited. This should be considered when interpreting the results.

Table 2. The prediction of private household consumption on sporting goods and service is based on public expenditure (PE) from the previous four years (t) and GDP per capita. The adjusted R^2 value is reported for each equation. The values in parentheses represent the standard error. Model 1: Total private consumption on sporting goods and services. Model 2: Total private consumption on attendance at sporting or recreational events plus participation in sport activities. Model 3: Total private consumption on attendance at sporting or recreational events. Model 4: Total private consumption on participation in sport activities.

Model	Intercept	PEt	PEt-1	PEt-2	PEt-3	PEt-4	GDPt	Adjusted R^2
1	-5.12*** (0.43)	0.08* (0.13)	-0.01 (0.15)	-0.008 (0.16)	-2.83*** (0.22)	0.35 (0.13)	0.47*** (0.05)	0.816***
2	-9.78*** (1.16)	0.67* (0.37)	-0.23 (0.41)	-0.50 (0.44)	-1.70** (0.61)	1.16 (0.36)	1.28*** (0.14)	0.861***
3	-21.65*** (2.66)	3.18* (1.10)	-1.20 (0.93)	-2.34* (1.03)	-0.37 (1.45)	1.14 (0.79)	2.20*** (0.34)	0.750***
4	-9.40*** (1.71)	0.63* (0.70)	-0.57 (0.60)	1.19 (0.66)	-1.83 (0.93)	0.91 (0.51)	1.25*** (0.21)	0.773***

Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, · $p < 0.10$.

Table 3 shows the results of the multiple linear regression analysis by educational level in both men and women. GDP per capita played a significant role in the total education group, as well as in the medium and high education levels, explaining more than 37.6% of the variance. Additionally, in the total education group, public expenditure was also selected by the model.

Table 3. Results of multiple linear regression models (log-transformed) predicting sedentary behaviour among men and women.

Model	Intercept β (SE)	Public expend. β (SE)	GDP per capita β (SE)	Age β (SE)	R ²	Adj. R ²	F
Total education (all levels)	278.24 (35.26)***	-7.57 (3.66)***	-18.66 (4.56)***	-0.10 (0.66)	0.4832	0.4689	33.66***
Low education level	229.92 (68.26)***	-6.42 (7.09)	-15.60 (8.83)	0.39 (1.28)	0.4457	0.3764	6.43***
Medium education level	314.87 (51.63)***	-8.80 (5.36)	-19.69 (6.68)**	-0.56 (0.97)	0.6999	0.6624	18.66***
High education level	284.08 (58.22)***	-8.85 (6.04)	-18.41 (7.53)*	-0.41 (1.09)	0.6276	0.5811	13.48***

Values are β coefficients with standard errors in parentheses. Expend., expenditure, Adj., Adjusted. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 4 shows the results of the multiple linear regression analysis by educational level in men. GDP per capita played a significant role in the total education group, as well as in the medium and high education levels, explaining more than 22.3% of the variance. In some subgroups, particularly those with lower educational attainment, the coefficients associated with public expenditure and GDP per capita were not statistically significant, indicating that the model explains less variation in sedentary behaviour for these populations.

Table 4. Results of multiple linear regression models (log-transformed) predicting sedentary behaviour among men based on public expenditure, GDP per capita, and age.

Model	Intercept β (SE)	Public expend. β (SE)	GDP per capita β (SE)	Age β (SE)	R ²	Adj. R ²	F
Total education (all levels)	231.39 (31.50)**	-6.06 (3.30)	-16.74 (4.22)***	0.28 (0.63)	0.4581	0.4430	30.43***
Low education level	174.46 (75.48)*	-3.61 (7.91)	-14.97 (10.11)	1.09 (1.51)	0.3090	0.2226	3.58***
Medium education level	269.03 (40.09)***	-9.51 (4.20)*	-15.89 (5.37)**	-0.42 (0.80)	0.7535	0.7227	24.45***
High education level	236.05 (52.29)***	-6.14 (5.48)	-16.79 (7.01)*	-0.03 (1.04)	0.5832	0.5311	11.20***

Values are β coefficients with standard errors in parentheses. Expend., expenditure, Adj., Adjusted. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 5 shows the results of the multiple linear regression analysis by educational level in women. GDP per capita played a significant role in the total education group, as well as in the medium and high education levels, explaining more than 45.9% of the variance. By way of explanation of what the table implies, as an example, when talking of women in total (at all education levels). The coefficient associated with public expenditure was negative and statistically significant, suggesting an inverse association between public expenditure and sedentary behaviour in this group. Age did not seem to play a significant role.

Table 5. Results of multiple linear regression models (log-transformed) predicting sedentary behaviour among women based on public expenditure, GDP per capita, and age.

Model	Intercept β (SE)	Public expend. β (SE)	GDP per capita β (SE)	Age β (SE)	R ²	Adj. R ²	F
Total education (all levels)	323.86 (40.50)***	-8.99 (4.09)*	-20.41 (4.96)***	-0.49 (0.70)	0.4603	0.4447	29.56***
Low education level	271.69 (67.07)***	-8.05 (6.77)	-16.35 (8.21)	-0.09 (1.17)	0.5186	0.4585	8.62***
Medium education level	366.81 (65.86)***	-8.93 (6.65)	-23.20 (8.07)**	-0.82 (1.15)	0.6530	0.6097	15.06***
High education level	333.29 (65.99)***	-11.24 (6.66)	-19.90 (8.08)*	-0.86 (1.15)	0.6431	0.5985	14.42***

Values are β coefficients with standard errors in parentheses. Expend., expenditure, Adj., Adjusted. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

5. Discussion

The objectives of this study were (i) to examine the influence of public expenditure on sports services and goods on private consumption and (ii) to assess whether the prevalence of sedentary behaviour could be predicted by public expenditure in sports, taking into educational level, and sex differences in European countries. In general, a strong correlation was observed between public expenditure and private consumption, while a lagged-variable model incorporating public expenditure over five years together with GDP per capita explained more than 75% of the variance in private sports consumption. Moreover, GDP per capita predicted sedentary behaviour in over 44.3% of cases across medium, high, and total education groups, both in the overall sample and when analysed separately by sex. Public expenditure also emerged as a significant predictor within the total education group (overall and among women) as well as within the medium education group among men. To the best knowledge of the authors, this study is novel in exploring the combined role of public expenditure and GDP per capita in predicting both private sports consumption and sedentary behaviour across European countries. These findings should be interpreted as statistical associations rather than causal relationships given the observational nature of the study.

The direct relationship between public expenditure and private consumption is not unexpected (table 1), as it has been observed in sectors such as education (Yu & Zhao, 2021) and health (Morgon, 2015). However, this relationship appears to be stronger, particularly in the years 2010 and 2015, when focusing on private consumption related to assistance in sporting or recreational activities (table 1). These findings align with another study that similarly report increased sports participation and consumption resulting from public infrastructure development (Pawlowsky *et al.*, 2007). In this regard, public infrastructure such as swimming pools is perceived by neighbourhood residents as relevant for engaging in sports activities (Wicker *et al.*, 2012). Moreover, sports activity in non-profit sports clubs can be enhanced by a good supply of sports programs offered by these clubs with support from municipalities. This support can take various forms, such as improving sports facilities or directly covering the cost of the activities offered by the clubs. (Peña & Espino, 2022). Nonetheless, the relationship between public expenditure and

private consumption disappears once GDP per capita is taken into account, even when analysing public investment made in previous years. The relevance of public expenditure remains only in relation to private consumption on attendance at sporting or recreational events plus participation in sport activities in the third year, or on attendance in the second year (Table 2). This is perhaps unsurprising, given that rising wealth is intrinsically linked to both higher public expenditure through increased tax revenues and greater private consumption via enhanced disposable income. Studies that fail to control adequately for this third variable risk confounding the relationship between the first two (Fedeli, 2015). For instance, recent research identified a stronger link between public spending and PA levels in wealthier countries, suggesting that the effectiveness of public investment may be conditional on broader economic circumstances (Szczepaniak, 2020). In the same vein, another analysis highlighted the stagnation of sports participation rates in the UK despite substantial public investment, implying that economic context or cultural norms may moderate policy outcomes (Weed, 2016). Conversely, an investigation reported a significant relationship between consistent investment in sports facilities and increased private spending on gym memberships, equipment, and recreational activities (Dallmeyer *et al.*, 2017). This discrepancy may stem from differing approaches to accounting for wealth; while Dallmeyer *et al.* (2017) used state-level GDP, GDP per capita may provide a more accurate measure of individual wealth and its effects. However, when analyzing the results of the multivariate study, it must be noted that the Durbin-Watson test was conducted for all years in total and returned a value of 1.96, indicating no evidence of first-order autocorrelation. The associated p-value (0.44) was not statistically significant, further supporting this interpretation. The VIF found strong collinearities for all lags of public expenditure (with $VIF > 10$); this is not surprising as they are all lagged indicators of the same variable. More relevantly however there was a low and acceptable level of collinearity with GDP per capita ($VIF = 2.85$). All in all, we fail to rule out autocorrelation, but multicollinearity seems to not be an issue in the model.

As for sedentary behaviour prevalence, this was predicted in more than 44.3% of cases for the medium, high, and total education groups: both in the full sample (men and women combined) (table 3) and separately for men (table 4) and women (table 5). This is consistent with a previous study that found that being more highly educated and living in certain regions or in densely populated areas tends to increase sports participation (García *et al.*, 2010). Moreover, public expenditure seemed to act as a significant predictor in a specific number of cases, in the total education group (for the full sample and for women only), as well as in the medium education level among men. These different results between men and women may be influenced by the differing levels of sedentary behaviour, with women generally exhibiting higher levels than men (Amagasa *et al.*, 2022; Pinto-Carbó *et al.*, 2021), except in countries like Iceland and Sweden (Eurostat, n.d.). In this regard, in order to reduce disparities, women's sports policies should take into account both the supply of sports activities and the maximization of infrastructure use, gender equity in the use of facilities, and the development of volunteering capacity (Casey *et al.*, 2019). It should also be noted that age did not seem to play a significant role. VIF values were examined in this model to test for possible multicollinearity. The values for government expenditure (3.19), GDP per capita (2.93) and median age of the population

(1.45) all showed low, acceptable levels of multicollinearity, so this was not an issue that might heavily affect findings. These data highlight the influence of GDP per capita on levels of sedentary behaviour, with this influence being stronger in the medium and high education groups, and no relationship observed in the low education group. This is consistent with a previous study that found PA levels to be strongly associated with macroeconomic factors such as GDP per capita, particularly in middle- and high-income countries, where higher levels of wealth are linked to lower rates of sedentary behaviour (Bauman *et al.*, 2012). These inequalities between countries can also be observed within a single country. For example, a study conducted in Hungary revealed growing disparities in sports expenditure, where higher-income households are more likely to engage in physical activities that reduce sedentary behaviour (Paar *et al.*, 2022). Along similar lines, another study noted that a higher level of education is associated with better knowledge about the importance of PA, which may positively influence the adoption of active behaviours, especially in urban areas with well-developed sports infrastructure (Puciato *et al.*, 2018). On the other hand, this current finding aligns with previous studies that have shown how public investment in sport can generate sustainable social benefits by promoting PA through a “virtuous cycle,” in which investment in sport (not assessed in the present study) leads to elite sport success, which brings national prestige, produces a “feel-good factor” in the population, and in turn increases sports participation (Grix & Carmichael, 2012). In this sense, a study conducted in the United Kingdom quantified that for every £1 invested in sport, £1.91 of social benefit was generated (Davis *et al.*, 2019). Research in Europe has found that greater availability of public sports infrastructure is associated with lower hospitalization rates due to cardiovascular diseases, particularly among individuals under the age of 65 (Jasiura *et al.*, 2023). These results reinforce the importance of inclusive, territorially oriented public policies to combat sedentary behaviour. However, it is worth noting that neither public expenditure nor GDP per capita predicts sedentary behaviour in the low education level group. This may be explained by structural and social barriers that limit the effectiveness of economic resources in promoting active lifestyles within this population. Factors such as limited access to sports infrastructure, lack of health education, unsafe environments, and time constraints related to precarious working conditions may reduce the capacity of individuals with lower education to engage in PA, regardless of broader economic improvements. Policies could focus on three main points: construction of facilities, elimination of barriers, and incentive programs, which would help reduce sedentary behavior (Volf *et al.*, 2022). In addition, a recent study (Wang and Zhang, 2024) found that public investment in education and health tends to yield more significant social returns in countries with stable and developed economies. In contrast, in less advantaged contexts, structural inequalities can hinder the translation of public spending into tangible outcomes like improved health or reduced sedentary behaviour, emphasizing the need for targeted, context-sensitive interventions.

This study has several limitations. First, the data covered only a limited period, with some variables, such as private household consumption, available at just three time points over 15 years, which restricts robustness. Second, the interdependence of European nations through shared policies or financial instruments (e.g., EU grants) may have introduced biases not fully controlled for. Third, additional variables such as urban

density or population could have strengthened the model, as they likely affect the supply of sporting goods and services. Fourth, education might be better treated as a control variable rather than a grouping one, but this would require a harmonized measure of average or median education across countries. Fifth, the analysis of sedentary behaviour was based solely on data from 2019, as these were the only ones available; this carries the risk that the situation in other years might have been different. Finally, sixth, although the Durbin–Watson test did not indicate first-order autocorrelation and VIF values suggested no serious multicollinearity (except with government expenditure lags), the results should be interpreted with caution, as the relatively small number of observations and the lagged model structure may limit robustness.

6. Conclusions

The conclusions of this study are as follows: (1) a strong correlation was observed between public expenditure on sports-related goods and services and private household consumption. However, this relationship proved misleading, as it was largely explained by national wealth. This finding stresses the importance of controlling for confounding variables when evaluating public–private dynamics and warns against policy decisions based solely on simple correlations. (2) When lagged models were applied, GDP per capita together with public expenditure explained over 75% of the variance in private sports consumption, confirming GDP per capita as the primary explanatory factor. From a practical perspective, policies that strengthen household purchasing power could indirectly foster higher levels of sports consumption, while investments in accessible infrastructure may serve as facilitators, particularly in lower-income communities. (3) Sedentary behaviour was predicted in more than 44.3% of cases across medium, high, and total education groups, with GDP per capita emerging as the strongest predictor. Public expenditure also appeared as a significant factor in certain educational and gender subgroups, underlining the importance of incorporating both economic and educational dimensions into public health strategies. (4) Populations with the lowest educational levels were least influenced by GDP per capita, age, or public expenditure. This suggests the need for targeted interventions, such as subsidized programmes, free access to exercise spaces, and tailored health campaigns, to promote active lifestyles and raise awareness of the benefits of physical activity among these groups.

7. References

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