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Sociodemographic and socioeconomic determinants of active daily travel, linked and unlinked to school, among schoolchildren in the Basque Country

Determinantes sociodemográficos y socioeconómicos del desplazamiento activo diario, vinculado y no vinculado al centro educativo, en escolares de Euskadi

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ABSTRACT

Objective: To analyze the prevalence of active commuting to school and daily active travel and to identify their sociodemographic, socioeconomic, and territorial determinants in the school-aged population.

Methods: A cross-sectional study was conducted in 1,032 schoolchildren aged 6 to 18 years from the Basque Country. Active commuting to school and daily active travel were assessed using self-reported questionnaires and classified as active or passive. Physical activity and sleep were objectively measured using actigraphy. Bivariate analyses and multivariable binary logistic regression models adjusted for sociodemographic, socioeconomic, and territorial variables were performed.

Results: Active commuting to school was reported by 59.8% of participants, and 64.2% reported daily active travel. In both cases, active travel was exclusively associated with higher levels of light physical activity. In adjusted models, active commuting to school was associated with sex, province, and the socioeconomic deprivation index, whereas daily active travel was associated with deprivation index, province, and type of school (public/private).

Conclusions: Active travel among schoolchildren shows a clear socioeconomic and provincial component, with partially different determinants

depending on whether it involves commuting to school or daily active travel. Its contribution is mainly observed in light physical activity, reinforcing the need for active mobility strategies adapted to the provincial context and socioeconomic inequalities.

KEYWORDS: active travel, physical activity, accelerometry, sleep, school-aged population.

RESUMEN

Objetivo: Analizar la prevalencia del desplazamiento activo centro educativo y del desplazamiento activo diario e identificar sus determinantes sociodemográficos, socioeconómicos y territoriales en población escolar.

Métodos: Estudio transversal en 1.032 escolares de entre 6 y 18 años del País Vasco. El desplazamiento al centro educativo y el desplazamiento activo diario se evaluaron mediante cuestionarios autoinformados y se clasificaron como activos o pasivos. La actividad física y el sueño se midieron objetivamente mediante actigrafía. Se realizaron análisis bivariados y modelos de regresión logística multivariable binaria ajustados por variables sociodemográficas, socioeconómicas y territoriales.

Resultados: El 59,8 % del alumnado realizaba desplazamiento activo al centro educativo y el 64,2 % presentaba desplazamiento activo diario. En ambos casos, el desplazamiento activo se asoció exclusivamente con mayores niveles de actividad física ligera. En los modelos ajustados, el desplazamiento activo al centro educativo se asoció con el sexo, la provincia y el índice de privación socioeconómica, mientras que el desplazamiento activo diario se asoció con el índice de privación, la provincia y el tipo de centro educativo (público/privado).

Conclusiones: El desplazamiento activo en población escolar presenta un claro componente socioeconómico y provincial, con determinantes parcialmente diferentes según se trate del desplazamiento al centro educativo o del desplazamiento diario. Su contribución se observa principalmente en la actividad física ligera, lo que refuerza la necesidad de estrategias de movilidad activa adaptadas al contexto provincial y a las desigualdades socioeconómicas.

PALABRAS CLAVE: desplazamiento **PALABRAS CLAVE:** deporte, liderazgo, mujer, sociedad.

INTRODUCTION

Insufficient physical activity (PA) in children and adolescents is one of the major current public health challenges worldwide. It is estimated that more than 80% of adolescents do not meet the minimum daily PA recommendations set by the World Health Organization (WHO) [1,2]. This situation has been associated with a higher cardiometabolic risk, poorer mental health, and an increased likelihood of maintaining sedentary lifestyles in adulthood [3].

In the European context, this problem is particularly relevant during compulsory schooling, a stage at which PA levels progressively decline with age, especially after the transition to adolescence [4,5].

In Spain, the available evidence shows a similar pattern, with insufficient PA levels in children and adolescents. Studies indicate that less than one-third of children and adolescents achieve the recommendation of at least 60 minutes of moderate-to-vigorous physical activity (MVPA) daily, with consistent inequalities based on sex and socioeconomic context [6–8]. In the Basque Country, this situation has contributed to the promotion of active lifestyles in school-aged children becoming a priority in the regional health and education policies, highlighting the need to intervene on everyday behaviors such as active commuting, which could have a population-wide impact [9,10].

In this same line, the Basque Country Report Card from the Global Matrix 5.0 project of the Active Healthy Kids Global Alliance has highlighted a decline in physical activity levels with age, high levels of sedentary behavior, and insufficient sleep duration among the children and adolescents in the Basque Country, as well as persistent gender inequalities [11].

In this context, active commuting, understood as the use of non-motorized modes of transportation like walking or cycling, has become a key opportunity to increase daily PA in children and adolescents [12,13]. Unlike other more structured forms of PA, active commuting is integrated into the daily routine and can cumulatively contribute to total PA levels, especially in school-age children [14].

Most of the existing literature has focused on active commuting to school due to its regular nature and potential to generate population-level benefits. In this area, several studies have observed positive associations between active commuting to school and higher daily PA levels, as well as with certain indicators of physical fitness, particularly cardiorespiratory fitness [14,15]. This approach has helped identify individual and environmental factors related to the mode of school transportation, solidifying the relevance of active commuting as a public health behavior [16,17].

Active commuting is not limited to the journey to school. Daily active travel encompasses other everyday trips, such as commuting to extracurricular activities, leisure spaces, or local services, and may present less structured patterns and be conditioned by environmental and contextual determinants different from those influencing school commuting [18,19]. This distinction is particularly relevant in a wide age range, such as from childhood to adolescence (6–18 years), where personal autonomy, time management, and use of the environment change significantly throughout the different educational stages [13,20].

However, the available evidence has primarily addressed active commuting to school, with limited studies analyzing both school commuting and daily active travel within the same population and geographic context, making it

difficult to gain an integrated understanding of active mobility patterns in children and adolescents [21].

Previous literature indicates that active commuting in childhood and adolescence is strongly conditioned by socioeconomic and territorial determinants [17]. Socioeconomic and contextual characteristics of the environment have been consistently associated with the mode of commuting, reflecting social gradients that influence opportunities and barriers for active mobility [20,21]. Additionally, territorial differences, even within the same country, can condition the likelihood of active commuting based on structural characteristics of the environment and local mobility context [18,22]. These factors may operate differently in school commuting and daily active travel, which reinforces the need for specific and differentiated analysis for each of these behaviors [19,23].

To date, although there are institutional projects and reports that analyze active mobility and commuting patterns in the Basque Country, such as post-COVID-19 mobility management and active transport habits in the general population [24], to our knowledge, no published scientific studies have integrated the analysis of both school commuting and daily active travel within the school population of the Basque Country.

Objective and Hypothesis of the Study

The objective of this study was to analyze the sociodemographic, socioeconomic, and territorial factors associated with active commuting to school and daily active travel in children aged 6 to 18 years in the Basque Country, using adjusted multivariable models to compare the determinants of both behaviors within the same population context. Concurrently, the hypothesis was proposed that both types of active commuting have partially different determinants and that their contribution is primarily associated with higher levels of light physical activity (LPA).

METHODOLOGY

Study Design

A cross-sectional observational study was conducted in children and adolescents from the Basque Country to analyze the factors associated with active commuting to school and daily active travel.

Participants and Sample

The sample consisted of children and adolescents aged 6 to 18 years attending schools in the Basque Country. Participants were recruited as part of the Mugikertu study on physical activity, sedentary behavior, and lifestyle habits in school-aged children, through collaboration with schools from the three provinces (Bizkaia, Gipuzkoa, and Álava) [25].

Participants who had valid information on their usual mode of commuting and valid accelerometry data were included in the study. Cases with incomplete data for the variables of interest were excluded. The final analyzed sample consisted of 1,032 participants.

Study Variables

The dependent variables in the study were active commuting to school and daily active travel. Both were assessed using self-reported questionnaires in which participants indicated their usual mode of transportation for daily commuting. Responses were categorized into three levels: passive transportation (private vehicle, bus, or electric scooter), active commuting by walking, and active commuting by bicycle or non-motorized scooter. Due to the low percentage of cycling or non-motorized scooter use, the commuting variables were recoded into a dichotomous format (active vs. passive) for inferential analysis.

Independent variables included age (years), sex (male/female), type of school (public/private), and participation in federated sports (yes/no). Socioeconomic status was assessed using the socioeconomic deprivation index of the area of residence (MEDEA), categorized into five levels, with level 1 corresponding to lower deprivation (higher socioeconomic status) and level 5 corresponding to higher deprivation. Territorial variables were also considered, including the province (Bizkaia, Gipuzkoa, and Álava) and the type of residence area (urban/non-urban).

Physical activity (PA), sedentary behavior, and sleep variables were assessed objectively using accelerometry. Daily time spent on sedentary behavior, light physical activity (LPA), moderate physical activity (MPA), vigorous physical activity (VPA), and MVPA were measured. Sleep variables included total sleep time, time in bed, sleep efficiency, and wake time after sleep onset. These variables were used for descriptive and bivariate analyses.

Procedure and Assessment Instruments

PA and sleep parameters were assessed objectively using accelerometry, with the ActiGraph WGT3X-BT accelerometer (ActiGraph, Pensacola, FL, USA). Participants wore the device on their non-dominant wrist for seven consecutive days. Records with a minimum of 10 hours per day for at least three days, including two weekdays and one weekend day, were considered valid. The device was removed only during aquatic activities.

From the records, objective measures of LPA, MPA, VPA, and MVPA, as well as sedentary time, were obtained. Sleep variables included total time in bed, total sleep time, wake time after sleep onset, and sleep efficiency. PA intensities were classified using previously validated cut-off points, following standardized protocols [25,26,27]. Additionally, participants completed a sleep diary to document sleep schedules, mode of transport, and type of PA performed.

Statistical Analysis

A descriptive analysis of all variables was performed. Continuous variables were expressed as mean and standard deviation (SD) or median and interquartile range (IQR), depending on their distribution, while categorical variables were presented as frequencies and percentages. Normality of continuous variables was assessed using the Shapiro–Wilk test.

Since continuous variables did not follow a normal distribution, associations between active commuting (to school and daily) and categorical variables were analyzed using chi-square tests, while continuous variables were compared using non-parametric tests (Mann–Whitney U test).

To identify possible differences in the determinants of active commuting to school and daily active travel, independent binary logistic regression models were estimated, considering active versus passive commuting as dichotomous dependent variables. Prior to estimating the models, multicollinearity among the independent variables included in the models was checked.

The models included sociodemographic, socioeconomic, and territorial variables, and odds ratios (OR) with their corresponding 95% confidence intervals (CI) were estimated. Analyses were performed using a complete-case approach, including only participants with available data for the variables included in each model.

The level of statistical significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics software (version 28).

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and current regulations regarding research with human beings. Approval was obtained from the Ethical Committee for Research on Medicines of Euskadi (Health Department of the Basque Government), in compliance with Law 14/2007 on biomedical research, with internal approval code PI2020011. Participation was voluntary, and written informed consent was obtained from the parents or legal guardians of the participants, along with assent from minors when applicable. Data were treated confidentially and anonymously, ensuring the protection of participants' personal information at all times.

RESULTS

Sample Characteristics

The final analyzed sample consisted of 1,032 schoolchildren and adolescents aged 6 to 18 years. The mean age was 11.82 years (SD = 3.49). The sex distribution was balanced, with 49.9% of participants being male and 50.1% female. Regarding the quality of the objective data, most participants provided between 6 and 7 valid days of accelerometry, indicating adequate

adherence to the measurement protocol. Sociodemographic characteristics and data quality are presented in Table 1.

Table 1. Sociodemographic Characteristics and Data Quality of the Sample (n = 1,032)

Variable	Total
Age (years) Mean ± SD	11,81 ± 3,48
6-11 years	558 (54,1)
12-18 years	474 (45,9)
Sex, n (%)	
Male	515 (49,9)
Female	517 (50,1)
Valid days of accelerometry n (%)	
6 days	400 (38,8)
7 days	478 (46,3)
Others (≤5 o ≥8)	154 (14,9)

Prevalence of Active Commuting

Among participants with valid commuting information (n = 989), 59.8% engaged in active commuting to school, and 64.2% reported daily active travel. In both cases, walking was the predominant mode of active commuting (56.8% to school and 60.3% for daily travel), while cycling or non-motorized scooter use represented a minority percentage. The detailed distribution of commuting modes is shown in Table 2.

Table 2. Prevalence and Mode of Active Commuting to School and Daily Active Travel (n = 989)

Modo of transport	n	% valid
Commuting to school		
Passive (car/bus/electric scooter)	398	40,2
Walking	561	56,8
Bicycle/non-motorized scooter	30	3,0
Dayly commuting		
Passive (car/bus/electric scooter)	354	35,8
Walking	596	60,3
Bicycle/non-motorized scooter	39	3,9

Note: Percentages calculated based on valid cases.

Bivariate Associations between Active Commuting, Physical Activity, and Sleep

In the bivariate analysis, students who engaged in active commuting to school showed higher levels of light physical activity (LPA) compared to those using passive modes of transportation (Table 3). No significant differences were observed between groups for moderate physical activity (MPA), vigorous physical activity (VPA), or MVPA, nor in the sleep variables evaluated for this outcome.

Similarly, daily active travel was associated with higher levels of LPA (Table 4). Significant differences were also observed in total sleep time, with the

group engaging in daily active travel having less sleep. No significant differences were found in MPA, VPA, MVPA, or other sleep indicators analyzed.

Table 3. Bivariate Comparison by Active Commuting to School

Variable	Passive	Active	*p*
LPA (min/day) Median [IQR]	1454,37 [1233,08–1662,83]	1525,00 [1299,92–1757,62]	< 0,05

Note: Comparisons were performed using the Mann–Whitney U test.

Table 4. Bivariate Comparison by Daily Active Travel

Variable	Passive	Active	*p*
LPA (min/day) Median [IQR]	1483,17 [1233,08–1666,00]	1511,83 [1290,75–1754,21]	< 0,05
Total sleep time (min) Median [IQR]	434,96 [387,14–473,43]	413,29 [[367,08–458,28]	< 0,001

Note: Comparisons were performed using the Mann–Whitney U test.

Factors Associated with Active Commuting (Multivariable Models)

The binary logistic regression model for active commuting to school showed a significant global fit ($\chi^2 = 32.04$; df = 11; $p < 0.001$). After adjusting for age, sex, socioeconomic deprivation index, province, urban environment, type of school, and participation in federated sports, independent associations were observed with sex, province, and socioeconomic deprivation index (Table 5).

Table 5. Factors Associated with Active Commuting to School

Variable	OR (IC 95 %)	*p*
Sex (female vs male)	1,38 (1,07–1,79)	0,014
Gipuzkoa vs Bizkaia	0,63 (0,47–0,86)	0,003
Álava vs Bizkaia	0,62 (0,43–0,90)	0,013
MEDEA 2 vs MEDEA 1	1,62 (1,07–2,47)	0,024

Women had a higher probability of engaging in active commuting to school compared to men (OR = 1.38; 95% CI: 1.07–1.79; p = 0.014). Regarding the reference province (Bizkaia), Gipuzkoa (OR = 0.63; 95% CI: 0.47–0.86; p = 0.003) and Álava (OR = 0.62; 95% CI: 0.43–0.90; p = 0.013) showed lower probabilities of active commuting. Concerning socioeconomic status, the MEDEA 2 level was associated with a higher probability of active commuting compared to the lowest deprivation level (OR = 1.62; 95% CI: 1.07–2.47; p = 0.024), while the other levels did not reach statistical significance. Age, urban environment, type of school, and participation in federated sports did not show significant associations in the adjusted model.

The binary logistic regression model for daily active travel also showed a significant global fit ($\chi^2 = 36.88$; df = 11; $p < 0.001$). In the adjusted analysis, daily active travel was independently associated with the socioeconomic deprivation index, province, and type of school (Table 6).

Table 6. Factors Associated with Daily Active Travel

Variable	OR (IC 95 %)	*p*
MEDEA 2 vs MEDEA 1	1,73 (1,13–2,64)	0,012
MEDEA 3 vs MEDEA 1	1,51 (1,02–2,22)	0,039
MEDEA 4 vs MEDEA 1	2,04 (1,28–3,25)	0,003
Gipuzkoa vs Bizkaia	0,49 (0,36–0,67)	<0,001
Álava vs Bizkaia	0,56 (0,38–0,82)	0,003
Public vs Private school	1,40 (1,06–1,86)	0,018

Compared to the reference socioeconomic level, MEDEA 2 (OR = 1.73; 95% CI: 1.13–2.64; p = 0.012), MEDEA 3 (OR = 1.51; 95% CI: 1.02–2.22; p = 0.039), and MEDEA 4 (OR = 2.04; 95% CI: 1.28–3.25; p = 0.003) showed higher probabilities of daily active travel, while MEDEA 5 did not reach statistical significance individually. Regarding the province, Gipuzkoa (OR = 0.49; 95% CI: 0.36–0.67; p < 0.001) and Álava (OR = 0.56; 95% CI: 0.38–0.82; p = 0.003) showed lower probabilities of daily active travel compared to Bizkaia.

Additionally, students from public schools had a higher probability of daily active travel compared to those from private schools (OR = 1.40; 95% CI: 1.06–1.86; p = 0.018). Age, sex, urban environment, and participation in federated sports were not significantly associated with daily active travel after adjusting for covariates.

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DISCUSSION

This study provides evidence on the coexistence of two patterns of active commuting in schoolchildren: commuting to school and daily active travel, with partially differentiated prevalences and determinants. The results show that daily active travel is more frequent than commuting to school and that both behaviors exhibit distinct associations with sociodemographic, socioeconomic, and territorial factors, reinforcing the need to analyze them as related but not equivalent behaviors, as recent studies have pointed out the limitations of considering school commuting as the sole proxy for daily active mobility in children and adolescents [28].

The observed prevalence of active commuting to school (59.8%) falls within a range comparable to other European contexts, where moderate prevalences of active commuting in school populations have been reported, with notable variability between studies and countries [13,14]. In this regard, previous literature has highlighted that factors such as urban structure, distance to school, and environmental characteristics play a relevant role in the adoption of active transportation modes [16–18].

Remarkably, daily active travel presented a higher prevalence (64.2%), suggesting that non-school everyday trips represent a significant source of active mobility in childhood and adolescence. This finding is particularly relevant, as most available evidence has traditionally focused on the school environment, with fewer studies analyzing both types of commuting together within the same population [19,21].

Bivariate analyses showed that active commuting, both to school and daily, was associated with higher levels of light physical activity (LPA), with no significant differences observed in moderate-to-vigorous physical activity (MVPA). This pattern is consistent with previous studies that have suggested that active commuting primarily contributes to increasing the total volume of daily movement rather than accumulating higher intensity PA

[12,14,29], in line with recent accelerometry evidence showing that the majority of daily movement in schoolchildren is concentrated in light intensities and that MVPA progressively decreases with age [30,31].

In fact, systematic reviews have described inconsistent results in the association between active commuting and MVPA, especially in contexts where the distances traveled are short and commuting is mostly done by walking [12,15]. These findings suggest that the impact of active commuting in schoolchildren may be more relevant from a perspective of reducing sedentary behavior and increasing daily movement, rather than strictly meeting MPA and VPA recommendations. However, it should be clarified that the biological contribution of LPA is modest compared to MVPA intensity, mainly acting as a daily energy expenditure accumulator.

Regarding sleep, no associations were observed with active commuting to school, while daily active travel was associated with lower total sleep time. The scientific evidence on the relationship between PA and sleep in children and adolescents is limited and heterogeneous, with inconsistent results across studies, suggesting that this finding should be interpreted with caution [32,33,34]. The lack of differences in other sleep quality indicators suggests that this association may reflect differences in daily time organization, schedules, or family routines, rather than a direct effect of active commuting on sleep.

Multivariable analysis showed that active commuting to school was independently associated with sex, province, and socioeconomic deprivation index. The higher probability of active commuting observed in females contrasts partially with some previous studies that have described greater male participation in active behaviors [35,36]. However, other studies have pointed out that these differences may vary considerably depending on the cultural context, perception of safety, and school environment organization, which could explain the discrepancies observed across studies [16,17].

The territorial differences observed between provinces align with literature that highlights the influence of the built environment, urban structure, and local mobility policies on active commuting patterns in young populations [18,22]. Even within the same country, these factors can generate clearly differentiated mobility patterns, underlining the importance of considering the territorial context in the analysis of active commuting.

The socioeconomic deprivation index showed a particularly relevant association with daily active travel, with higher probabilities of active commuting in the intermediate deprivation levels. This nonlinear pattern is consistent with previous studies that have described complex social gradients in active mobility, where both more privileged and more disadvantaged contexts may present lower levels of active commuting for different reasons, such as a greater reliance on motorized transport or structural limitations of the environment [16,19].

Furthermore, the higher probability of daily active commuting observed in students from public schools compared to private schools has been previously described and could be related to differences in the location of schools, the socioeconomic profile of the students, or the daily distances traveled, although these variables could not be assessed in the present study [17].

In summary, the results suggest that strategies to promote active commuting in school populations should consider the differentiated roles of commuting to school and daily active travel, as well as the socioeconomic and territorial inequalities that influence both behaviors. Interventions solely focused on the school environment may miss a substantial part of daily active mobility. In this sense, it is imperative that Physical Education teachers

lead transferable interventions such as active school travel programs and service-learning projects, coordinating the promotion of active mobility with task designs that ensure optimal MVPA levels during school hours, thus compensating for the low-intensity profile of daily commuting.

LIMITATIONS AND FUTURE DIRECTIONS

Among the main limitations of the study is its cross-sectional design, which prevents establishing causal relationships between the analyzed variables, as well as the use of self-reporting for evaluating active commuting, which is susceptible to recall biases or social desirability biases. Furthermore, the absence of specific environmental variables, such as distance to school or perceived traffic safety, limits the explanatory capacity of the multivariable models. Additionally, by focusing on behavioral determinants, physical health indicators (such as BMI) were not included, which should be considered when interpreting the clinical relevance of the results.

However, the study presents significant strengths, including the large sample size, the inclusion of an age range covering both childhood and adolescence, the use of accelerometry for objective PA measurement, and the differentiated analysis of two conceptually distinct active commuting behaviors within the same population context.

Future studies should further analyze active commuting by incorporating specific environmental variables, such as the distance to school or characteristics of the built environment, and explore possible differences according to educational stages using longitudinal designs, following multidimensional approaches that integrate individual, social, and environmental factors, as proposed in recent initiatives developed in the Spanish context [37].

CONCLUSIONS

In this large sample of schoolchildren and adolescents, daily active commuting was more frequent than active commuting to school, reinforcing the need to consider both behaviors separately in active mobility research. The results show that active commuting is primarily associated with socioeconomic and territorial factors, rather than individual or sports-related characteristics.

The socioeconomic deprivation index and province were identified as consistent determinants of active commuting, especially in daily active commuting, highlighting the influence of social and territorial context on the adoption of active transportation modes, which emphasizes the need for urban planning and community pediatrics policies that prioritize the most vulnerable environments to reduce the identified health inequalities. Moreover, the type of school was associated with daily active commuting, emphasizing the relevance of the school and community environment in the daily mobility of students.

From an active behavior perspective, active commuting was related to higher levels of LPA, with no significant differences in MPA, VPA, or MVPA. Overall, these results highlight the importance of addressing active commuting from a social and territorial perspective. Future studies should incorporate environmental variables and longitudinal designs to further explore the determinants of active commuting.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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