safety

Article

Using the MAPS-Global Audit Tool to Assess the Influence of Microscale Built-Environment Attributes Related to Physical Activity and Sedentary Behavior in Spanish Youth

Marta Terrón-Pérez [1,2], Javier Molina-García [2,3,4,*], Elena Santainés-Borredá [1], Isaac Estevan [2,3] and Ana Queralt [1,2,4]

[1] Department of Nursing, University of Valencia, 46010 Valencia, Spain; marta.terron@uv.es (M.T.-P.); elena.santaines@uv.es (E.S.-B.); ana.queralt@uv.es (A.Q.)
[2] AFIPS Research Group, University of Valencia, 46022 Valencia, Spain; isaac.estevan@uv.es
[3] Department of Teaching of Physical Education, Arts and Music, University of Valencia, 46022 Valencia, Spain
[4] Epidemiology and Environmental Health Joint Research Unit, FISABIO-UJI-UV, 46020 Valencia, Spain
* Correspondence: javier.molina@uv.es

Abstract: Environmental factors have been identified as having a direct relationship with physical activity (PA) and sedentary behavior. The main aim of this study was to investigate the relationship between microscale built-environment attributes and the levels of PA and sedentary behavior in young people. This study included 465 adolescents (55% girls) between 14 and 18 years from Valencia, Spain. Accelerometers and self-reported questionnaires were used to measure PA, including active commuting, and sedentary behavior, and the MAPS (Microscale Audit of Pedestrian Streetscapes)-Global tool was used for microscale variables. Mixed-effects regression models were used for data analysis. Higher levels of moderate-to-vigorous activity were identified when more positive elements were found in the street characteristics. Greater active commuting in the neighborhood had a positive relationship not only with more positive elements of land use and destinations but also with the overall score of the MAPS-Global tool. The sedentary levels were higher when higher levels of negative aesthetics and social characteristics were identified, and the participants were less sedentary when more bike facilities were observed. The main results of this study provide us with evidence of the relationship between the microscale variables of the built environment and both PA and sedentary behavior.

Keywords: accelerometry; active transport; adolescence; environment design; exercise; measurement; walkability

check for updates

Citation: Terrón-Pérez, M.; Molina-García, J.; Santainés-Borredá, E.; Estevan, I.; Queralt, A. Using the MAPS-Global Audit Tool to Assess the Influence of Microscale Built-Environment Attributes Related to Physical Activity and Sedentary Behavior in Spanish Youth. *Safety* **2024**, *10*, 73. https://doi.org/10.3390/safety10030073

Academic Editor: Raphael Grzebieta

Received: 8 June 2024
Revised: 1 August 2024
Accepted: 12 August 2024
Published: 14 August 2024

1. Introduction

Physical activity (PA) involves physical, psychological, social and cognitive benefits [1]. However, among the young population, the levels of sedentarism and physical inactivity are very high [2,3]. Active transport (i.e., cycling or walking) is an opportunity for being physically active and helps establish healthy lifestyles [4,5]. Although it represents a great opportunity for the young population, a decrease in active transport has been observed in the last years [6,7].

From an ecological model perspective, PA can be influenced by numerous factors, such as individual, social and institutional factors, community, built environment and policy [8,9]. In recent years, environmental factors have been identified as having a direct relationship with PA levels and active travel [10,11]. The review performed by Ortegon-Sánchez [12] indicated the environmental factors that positively influence active travel and PA in children, which were, among others, safety, street connectivity, accessibility or proximity to facilities and pedestrian infrastructure that facilitate walking and cycling.

Within the environmental variables, macroscale [13] and microscale [14] factors can be differentiated. Macroscale variables are those not easily modified, such as neighborhood design, residential density, street connectivity and land use [13,15]. For adolescents, macroscale factors that influence the PA levels can vary depending on the measuring instrument, as indicated in the reviews by Ding et al. [16] and Ortegon-Sanchez et al. [12]. In these reviews, positive associations between PA levels and two objectively measured environmental variables, which were residential density and land use mix, were observed. In relation to intersection density, controversial results were obtained in studies performed with rural adolescents [17,18]. In the Spanish context, there is not clear evidence about which macroscale variables are related to the PA levels in adolescents [19]. The concept of walkability usually refers to environmental macroscale factors such as land use mix, residential density and street connectivity [20]. From the combination of these and other factors, turned into indexes, neighborhood walkability can be known in relation to the study of active lifestyles [21].

On the other hand, microscale variables are those that refer to specific details and characteristics of the neighborhood, such as aesthetics, streetscape design and characteristics, street lighting, traffic, etc. [14,22,23]. Microscale land-use measurements can help us understand why people choose certain routes or places and increase the PA performed by the population [24,25]. These details are thought to affect safety, comfort and reliability for active transport [26,27]. Although microscale variables are the easiest to modify [28], they are the least studied [26,29]. Likewise, there are few evaluation instruments to evaluate the micro-environmental characteristics whose validity has been analyzed [28,30].

The MAPS (Microscale Audit of Pedestrian Streetscapes)-Global tool was developed from the previous MAPS tool, which was designed to assess pedestrian environments and their characteristics [31,32] along with eight other instruments, aiming for international applicability [28]. The MAPS-Global tool primarily facilitates the measurement of microscale elements such as sidewalk design and street crossing safety, as well as some macroscale elements [28]. The tool has proven feasible and reliable for use in various urban contexts [28,33–36]. In the last decade, few studies have used this tool to identify elements of the built environment affecting active transportation and walkability [30,37], and another version of the MAPS (MAPS-Mini) was used in a pilot intervention study [38].

In the literature, the microscale built-environment attributes have been little explored, which is why the present study was proposed. The main objective was to evaluate the validity of the MAPS-Global tool by examining the relationship between microscale variables and the levels of PA and sedentary behavior in young people in the city of Valencia. In particular, we hypothesized the following: (1) a more favorable environment is positively associated with the levels of PA; (2) negative built-environment elements are positively associated with sedentary behaviors. Additionally, the reliability of the tool was analyzed by comparing the audits carried out on street with those carried out online through Google Street View.

2. Materials and Methods

2.1. Procedure and Participants

We used data from the International Physical Activity and Environment Network (IPEN) Adolescent Study in Spain, a cross-sectional study performed between 2013 and 2015. A total of nine secondary schools in Valencia (Spain) participated in the study. A final sample of 465 adolescents (55% girls) between 14 and 18 years was collected [19].

The inclusion criteria were as follows: adolescents aged between 12 to 18 years, living in Valencia (Spain) and being able to walk without assistance. Data collection was performed during the school year, and the participation rate was approximately 80%.

The schools were selected to consider different walkability and socio-economic status characteristics. The selection of the schools was carried out objectively by census blocks, with different SES and walkability neighborhoods. The city of Valencia is divided into 593 census blocks. Census blocks are the smallest administrative units that the Geographic

Information System (GIS) uses to classify groups with high or low walkability, according to net residential density, land use mix and intersection density [see Molina-Garcia et al. [19] for more information]. As in previous research [19], the SES was established according to the educational level of each census unit (data obtained from the National Institute of Statistics of Spain, INE). Each census unit was grouped into deciles, according to walkability and SES. This allowed four groups of census units to be established, i.e., with low walkability (first five deciles) or high walkability (the remaining five deciles) and, in the same way, based on the SES. With this, a 2×2 matrix was defined for high/low walkability and high/low SES. ArcGIS 10.2 software (ESRI, Redlands, CA, USA) was used to calculate these variables.

The study was conducted according to the Declaration of Helsinki and the ethic code of the American Psychological Association. Approval was obtained from the Human Research Ethics Committee at the University of Valencia. An informed consent form was delivered and signed by the legal guardian/s of the adolescents, prior to data collection.

2.2. Measures

Microscale built-environment attributes. MAPS-Global is a valid [26] and reliable tool [39] for evaluating pedestrian environments and microscale environmental characteristics. The MAPS-Global was designed for all ages and for international use [28]. The tool has 123 items to evaluate microscale environmental characteristics on streets, sidewalks and intersections and design characteristics. It is divided into 4 sections: overall route, street segment, street crossing and cul-de-sacs. Each section has its corresponding subscales/subsections (detailed in Table 1).

Table 1. Variable groupings in MAPS-Global.

Subscales	Items Included
Positive destinations and land uses	Restaurants, shops, residential density, institutional services, workship, schools, bicycle shops, public and private recreation
Negative destinations and land uses	Age-restricted bars, liquor or alcohol stores
Overall destinations and land use	Positive destinations and land uses—negative destinations and land uses
Positive streetscape	Transit, traffic calming devices, street amenities (trash bins, benches, bike racks, bike lockers, kiosks, hawkers)
Positive aesthetics and social	Hardscape, water, softscape, landscaping
Negative aesthetics and social	Buildings not maintained, graffiti, litter, dog fouling, extent of physical disorder, nearby highway
Overall aesthetics and social	Positive aesthetics and social—negative aesthetics and social
Positive segments	Condition of buildings, presence of sidewalks, presence of buffers, presence of bicycle infrastructure, presence of windows, presence of shadows, presence of pedestrian infrastructure, presence of informal paths (shortcut), presence of street vendors or shops, presence of tall buildings
Negative segments	Non-continuous sidewalks, trip hazards, obstructions, cars blocking walkway, slope, gates, driveways
Overall segments	Positive segments—negative segments
Positive crossing	Crossing aids, marked crosswalks, high-visibility striping, different material than road, curb extension, raised crosswalks, protected refuge islands, curb quality, place on a pedestrian overpass, underpass or bridge, waiting areas, bike lane crossing the crossing, bike signals, intersection control
Negative crossing	Distance of crossing leg
Overall crossing	Positive crossing—negative crossing
Pedestrian infrastructure	Trails, ped zones, sidewalk presence and width, buffers, shortcuts, midsegment crossing, pedestrian bridges, air-conditioned place to walk, low lights, overpasses, crosswalks, refuge islands

Table 1. *Cont.*

Subscales	Items Included
Pedestrian design	Open-air markets, trash cans, benches, kiosks, hawkers and shops, setbacks, windows, pedestrian walk signals, push buttons, countdown signals, ramps, crossing aids
Bike facilities	Bike racks, docking stations, lockers, bike lanes, bike lane quality, signs, bike signals, bike boxes, bike lane crossing the crossing
Overall microscale positive	Positive destinations and land uses + positive streetscape + positive aesthetics and social + positive segments + positive crossing
Overall microscale negative	Negative destinations and land uses + negative aesthetics and social + negative segments + negative crossing

MAPS, Microscale Audit of Pedestrian Streetscapes.

The route section consists of land use/destinations, streetscape, aesthetics and social. Both sides of the streets were audited. For the segment section, the characteristics of the sidewalks, slopes and the concentration and characteristics of buildings and bicycle zones were evaluated. Only one side of the streets was audited. The crossing included pedestrian safety, crossing signs, types of crossing signs, visibility, width of the crossings and presence of bicycle services. Crossings found on marked routes were evaluated. The cul-de-sac section included the proximity of the cul-de-sac opening to the participant's home, amenities in the cul-de-sac and visibility of the cul-de-sac area from the participant's home. This section was only completed if the adolescent's residence was located 120 m from a dead end.

Sixty-four adolescents of different SES of the total of 465 participants in the IPEN study were randomly selected. The IPEN Coordination Center identified each route's destination as the nearest commercial block. Routes were manually created (400–724 m) from each residence toward a commercial block using Google Earth. The routes were drawn along the road network, providing the most direct route from the residence to a non-residential destination [28]. Figure 1 shows the routes created and audited in the study.

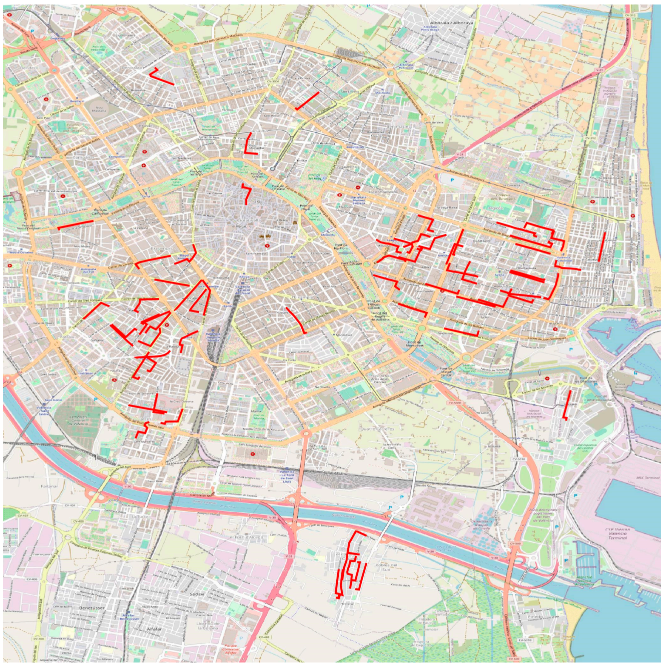

Figure 1. Spatial distribution of audited routes (in red) in the city of Valencia, Spain. Data source of base map: OpenStreetMap contributors (https://www.openstreetmap.org). Created using QGIS 3.28 software (https://www.qgis.org).

A training of the tool was carried out by the IPEN Coordination Center. They provided the training materials and procedures. After the training and before starting the observations of the study, it was required that three observers completed five routes with 95% of inter-rater agreement.

The tree raters carried out the observations with the same MAPS-Global tool. Two of them audited on street and one audited online using both Google Earth and Google Street View tools.

Physical activity and sedentary time. ActiGraph GT3X+ accelerometers were used to objectively measure moderate-to-vigorous physical activity (MVPA) and sedentary time. These instruments have demonstrated to be valid and reliable in adolescents [40]. The participants were instructed to wear the accelerometer during 7 days. The data were aggregated to 30 s epochs. A valid day was considered when the accelerometer had been worn at least 10 h in a weekday and 8 h in a weekend day. Non-wear time was considered for 60 or more seconds of zero counts. The participants should have at least 5 valid days and at least one weekend day. MeterPlus version 4.3 software was used to process the accelerometer data. PA and sedentary behavior were classified using Evenson cutpoints [41] as follows: $\leq$50 counts per 30 s epoch, sedentary time; and $\geq$1148 counts per 30 s epoch, MVPA.

Active commuting in the neighborhood. The following question was asked to assess active commuting in the neighborhood: "Not counting trips to or from school, how far do you travel alone or with friends, without your parents?". If the participants did not make any trip, the answer was 0; in the affirmative case, the participants indicated the number of minutes traveled from home, one way, walking and/or cycling. The total active commuting minutes in the neighborhood were calculated. The question was developed by IPEN researchers (see https://ipenproject.org/resource-hub/resources/, accessed on 12 August 2024).

Sedentary behaviors. The adolescents were asked about the time they spent on the following sedentary activities in a school day: watching TV/DVDs, playing inactive video games, using the Internet for leisure, doing schoolwork, reading for leisure and traveling by motorized transportation. The answers could vary from none to 15 min, 30 min, 1 h, 2 h, 3 h and 4 h or more hours a day. The total minutes per day in sedentary behaviors were calculated. Norman et al. [42] and Rosenberg et al. [43] found good validity and reliability.

Covariates. Sociodemographic measures (i.e., gender, age and parental education level), active commuting behavior and psychosocial factors were assessed by a paper questionnaire, completed by the adolescents. The adolescents were asked to indicate the level of education of their parents from 1 (none) to 5 (university training).

2.3. Data Analysis

SPSS software (v22.0; SPSS, Chicago, IL, USA) was used to perform the statistical analyses. The tests were considered significant when $p < 0.05$. For inter-rater reliability, a comparison was made between the observations of on-street evaluator 1 and on-street evaluator 2, those of the online evaluator and on-street evaluator 1 and those of the online evaluator and on-street evaluator 2. Intraclass correlation coefficients (ICCs) were interpreted according to Landis and Koch [44] ratings: 0.81–1.00 (almost perfect), 0.61–0.80 (substantial), 0.41–0.60 (moderate), 0.21–0.40 (regular), 0.00–0.20 (poor). To study the relationship between PA and sedentary behavior with the MAPS-Global tool, mixed linear regression models (SPSS MIXED) were used. The models were adjusted to four factors (i.e., gender, age, parental educational level and walkability) as fixed effects, and the participants were grouped into schools and neighborhoods (administrative units) as random effects. Mixed linear regression analyses are an extension of simple linear regression analyses to allow for both fixed and random effects [45]. The statistical assumptions of a mixed-effects model involve, among other things, independence of the random effects vs. covariates.

3. Results

3.1. Reliability of the Evaluators

Observations of sixty-five routes by the evaluators were compared. Two evaluators made on-street observations, and one evaluator made online observations. Table 2 provides the reliability results. The reliability of on-street evaluators obtained very positive results for all the item, with ICCs ranging from 0.877 to 1. When comparing on-street and online evaluators, a reliability greater than 0.8 was obtained except for the aesthetics and social item. The ICC values of 0.642 and 0.613 were obtained for the overall aesthetics and social subscale, and ICC values of 0.380 and 0.267 were obtained for the negative related items.

Table 2. Summary of inter-rater reliability results from MAPS-Global.

	Reliability of On-Street Evaluators (R1–R2) ICC	Reliability of Online and On-Street 1 Evaluators (R2–R3) ICC	Reliability of Online and On-Street 2 Evaluators (R1–R3) ICC
Positive destinations and land uses	0.998	0.977	0.980
Negative destinations and land uses	0.967	0.828	0.860
Overall destinations and land uses	0.998	0.978	0.979
Positive streetscape	0.994	0.966	0.965
Positive aesthetics and social	0.982	0.989	1
Negative aesthetics and social	0.877	0.380	0.267
Overall aesthetics and social	0.898	0.642	0.613
Positive segments	0.980	0.987	0.973
Negative segments	1	0.915	0.915
Overall segments	0.983	0.986	0.971
Positive crossing	1	0.995	0.996
Negative crossing	1	1	1
Overall crossing	1	0.995	0.996

MAPS, Microscale Audit of Pedestrian Streetscapes; R, rater; ICC, intraclass correlation coefficient.

3.2. MAPS-Global Microscale Variables and PA Behaviors

Examining the relationship between the microscale variables and the objectively measured PA levels of young people in the city of Valencia (Table 3), higher levels of MVPA were identified when more positive elements were found in the segments ($p = 0.022$). In addition, greater active commuting in the neighborhood had a positive relationship with the following subscales: positive elements of land use and destinations ($p = 0.004$), overall destinations and land use ($p = 0.003$), overall microscale positive ($p = 0.006$) and grandscore ($p = 0.004$). A negative relationship was found with negative segments ($p = 0.002$) and overall microscale negative ($p = 0.042$) scores.

Table 3. Mixed-regression results for relations between MAPS-Global scores and physical activity.

MAPS-Global Scores	MVPA (min/Day)		AC (min/Trip)	
	t	*p*	*t*	*p*
Positive destinations and land uses	0.351	0.728	3.117	**0.004**
Negative destinations and land uses	0.579	0.565	−0.241	0.810
Overall destinations and land uses	0.310	0.758	3.313	**0.003**
Positive streetscape	−1.653	0.110	1.843	0.083
Positive aesthetics and social	0.567	0.574	1.731	0.092
Negative aesthetics and social	−0.148	0.883	−0.419	0.678
Overall aesthetics and social	0.425	0.674	1.275	0.211
Positive segments	2.359	**0.022**	−0.607	0.546
Negative segments	0.559	0.578	−3.309	**0.002**
Overall segments	1.960	0.055	0.102	0.919
Positive crossing	0.052	0.959	−0.286	0.776
Negative crossing	−0.088	0.930	0.100	0.921

Table 3. *Cont.*

MAPS-Global Scores	MVPA (min/Day)		AC (min/Trip)	
	t	*p*	*t*	*p*
Overall crossing	0.058	0.954	−0.339	0.736
Pedestrian infrastructure	0.984	0.330	−1.068	0.291
Pedestrian design	0.009	0.993	1.152	0.258
Bike facilities	0.908	0.368	−0.447	0.657
Overall microscale positive	0.275	0.785	2.981	**0.006**
Overall microscale negative	0.566	0.574	−2.097	**0.042**
Grandscore	0.209	0.835	3.183	**0.004**

MAPS, Microscale Audit of Pedestrian Streetscapes; MVPA, moderate-to-vigorous physical activity; AC, active commuting. Note: Bold values indicate statistically significant differences ($p < 0.05$).

3.3. MAPS-Global Microscale Variables and Sedentary Behaviors

As shown in Table 4, the objectively measured sedentary time was higher when a negative aesthetics and social subscale ($p = 0.016$) was identified. In relation to sedentary behaviors measured by the time spent in certain sedentary activities, the adolescents were less sedentary when more bike facilities were identified ($p = 0.055$).

Table 4. Mixed-regression results for relations between MAPS-Global scores and sedentary behaviors.

MAPS-Global Scores	Sedentary Time (min/Day)		Sedentary Activities (min/School Day)	
	t	*p*	*t*	*p*
Positive destinations and land uses	0.983	0.329	0.206	0.838
Negative destinations and land uses	−0.023	0.982	−0.366	0.716
Overall destinations and land uses	1.001	0.321	0.238	0.813
Positive streetscape	−0.052	0.959	1.402	0.166
Positive aesthetics and social	−0.356	0.723	−1.573	0.121
Negative aesthetics and social	2.469	**0.016**	−0.764	0.448
Overall aesthetics and social	−2.148	**0.036**	−0.260	0.796
Positive segments	0.019	0.985	−1.763	0.083
Negative segments	−0.526	0.600	−.889	0.377
Overall segments	0.435	0.665	−1.411	0.163
Positive crossing	0.768	0.445	−1.419	0.161
Negative crossing	0.337	0.737	−1.149	0.255
Overall crossing	0.764	0.448	−1.319	0.192
Pedestrian infrastructure	0.503	0.617	−0.371	0.712
Pedestrian design	0.066	0.947	0.075	0.940
Bike facilities	0.296	0.768	−1.953	**0.055**
Overall microscale positive	0.895	0.374	0.104	0.917
Overall microscale negative	1.548	0.127	−1.555	0.125
Grandscore	0.728	0.469	0.270	0.788

MAPS, Microscale Audit of Pedestrian Streetscapes; Note: Bold values indicate statistically significant differences ($p < 0.05$).

4. Discussion

The present study evaluated the reliability of the MAPS-Global tool to assess the built environment in the city of Valencia. In general, high inter-rater reliability was found, indicating that it is an effective tool for use in the Spanish context, both on street and online. On the other hand, microscale variables that influence adolescents' PA, active commuting in the neighborhood and sedentary behavior were identified. The results showed that the hypotheses of the study were confirmed.

4.1. Reliability of the Evaluators

The results of the reliability of the tool were very positive when comparing on-street evaluators and online and on-street evaluators. These results give us the possibility of using the tool online without the need to travel to places, speeding up data collection in subsequent research. The only item that made a difference was that including the aesthetics and social elements. This may be due to the fact that the online tool does not always allow for the observation of certain elements such as dog poop, elements that cause tripping or the presence of cars that do not allow pedestrians to pass. Studies by Vanwolleghem et al. [30] and Fox et al. [34] found similar results in relation to the aesthetics and social elements. Another possible explanation is that, since the measurement of aesthetics and social elements is more subjective, differences can be present when comparing the observations of different evaluators. Furthermore, in the validation of the Maps-Global tool for international use [28], lower ICCs were found for aesthetics and social elements. Because of the sustained interest in having these types of measures available for analysis, aesthetics and social characteristics have continued to remain part of the MAPS-Global tool [34]. Nevertheless, caution is needed when interpreting the results.

4.2. Microscale Built-Environment Attributes and PA

Taking into account the MAPS-Global tool results, those people who have a more favorable environment will commute more actively in their neighborhood or will have higher levels of PA; several positive aspects appeared significant (e.g., positive destinations and land uses, positive streetscape, positive aesthetics and social elements, positive segment elements and positive crossing elements).

Few studies focused on microscale variables and their relationship with PA or active commuting. In this sense, it is worth highlighting some studies that analyzed the factors at the microscale level and active commuting to school. On the one hand, Pocock et al. [46] did not find any association between active commuting to school and the overall MAPS-Global tool results or the rest of the variables. However, the study by Molina-García et al. [18] found significant associations between the combination of different micro and macro environmental factors and active commuting to school for adolescents from urban and rural environments.

In our case, higher levels of MVPA were found with more positive segment elements, and lower active commuting with more negative segment elements. The condition of the buildings, the presence of sidewalks, the presence of shadows, etc., could positively favor PA performance, and negative elements such as non-continuous sidewalks, trip hazards, obstructions, cars blocking walkways could not. Cain et al. [26] found other associations for other age groups. The results of that study coincide with our results in terms of positive elements associated with higher PA levels. In addition, Pizarro et al. [47] found higher active commuting in environments with adequate public lighting.

The results suggest that great maintenance and presence of positive elements and low presence of negative elements favor healthier PA levels and active commuting.

The positive destinations and land uses scale and the overall destinations and land uses scale showed the expected results in this study. The more the destinations to move around (restaurants, shops, public and private recreation facilities, etc.), the more attractive a neighborhood can be, consequently increasing the active commuting around that neighborhood. These results are similar to those found by Cain et al. [26], according to which adolescents showed high active commuting when there was greater residential use, more restaurants and more leisure destinations. On the other hand, Nelson and Woods [48] also found more active commuting when there were more stores available. These results could be taken into account at the local level for the organization of neighborhoods in order to make them more attractive to the young population, increasing the variety of destinations to which adolescents can commute.

In relation to the rest of the variables, no associations were found. Future studies could analyze whether there are differences between rural and urban environments, as shown in the study by Molina-Garcia et al. [18]. In this study, more active commuting was found in urban environments when the streets had more positive characteristics and in both rural and urban environments when the quality of the crossings was high.

More associations were found with the reported measures than with objective measures obtained by accelerometry. A possible explanation could be that the reported measures are related to a certain domain of PA (i.e., active commuting), which could be more affected by the environment, and not to total PA. Using a microscale tool, it may be possible to find stronger associations with the reported measures (such as neighborhood commuting or active commuting to school). In this way, we would be able to better understand what variables can favor the decision by adolescents to be more active. The study by Cain et al. [26] and that of Sallis et al. [49] in adults found similar results.

4.3. MicroScale Built-Environment Attributes and Sedentary Behavior

To our knowledge, there are no studies that relate microscale variables of the environment to sedentary behavior. However, in our study, when more negative aesthetics and social elements were found (presence of graffiti, litter, presence of dog fouling, presence of a nearby highway, etc.), the adolescents had a more sedentary lifestyle. This is consistent with what was found by Nelson and Woods [48] and Van Kann et al. [50], who found more active commuting in environments free of garbage. Taking these microscale variables into account, reinforcing street cleaning or carrying out campaigns to raise awareness to contribute to making the streets cleaner (e.g., increasing surveillance/fines for people who do not collect dog poop, setting a space in neighborhoods for graffiti and prohibiting them in the rest of the neighborhoods, etc.) are community actions with little cost that would improve the health of the population.

On the other hand, the higher the number of bike facilities (bike racks, docking stations, lockers, bike lanes, bike lane quality, signs, bike signals, etc.), the lower the levels of sedentary lifestyle. A study by Pocock et al. [46] found no relationship between cycling facilities and active transportation. Being a new topic, more studies are needed to explore the microscale variables in relation to bicycle use in order to identify its facilitators, especially in other cities and geographical contexts where the use of the bicycle as a means of transport is more frequent.

4.4. Strengths and Limitations

There are few investigations that analyzed the relationship of PA and/or sedentary behaviors with microscale variables and even less studies that used the MAPS-Global tool. This research provides new data to this field of study.

In relation to its limitations, the present study was carried out in a single city, which makes it difficult to extrapolate its results. In future studies, it would also be interesting to evaluate and compare the levels of PA and sedentary behaviors not only in urban areas but also in rural contexts. In addition, the cross-sectional design is another limitation. Therefore, natural experiments and longitudinal follow-up studies are needed in the future. The audits were performed both on street and online. Although online methods have advantages, they also present some limitations. These limitations include time differences between collection of the imagery and related online observations and the difficulty to view some characteristics due to the camera's perspective [51]. These limitations might explain the lower reliability results for the aesthetics and social environment variables in the present study and in others [51]. However, these lower reliability results might also be explained by the transitory and qualitative judgement of these characteristics [34,52]. Finally, objective measures were used to measure PA, but also self-reported measures by adolescents for both PA and sedentary behavior.

5. Conclusions

The results found provide us with evidence of the relationship between the microscale variables of the built environment and both PA and sedentary behavior. Modifying the microscale elements of the built environment is easier than modifying the macroscale elements. Therefore, the present results can help local administrations to suggest changes in neighborhoods and thus improve the health of the young population, specifically, as shown by the present study, in the city of Valencia.

Author Contributions: Conceptualization, J.M.-G. and A.Q.; methodology, J.M.-G. and A.Q.; formal analysis, J.M.-G. and A.Q.; investigation, M.T.-P., J.M.-G., E.S.-B., I.E. and A.Q.; data curation, J.M.-G. and A.Q.; writing—original draft preparation, M.T.-P.; writing—review and editing, M.T.-P., J.M.-G., E.S.-B., I.E. and A.Q.; supervision, J.M.-G. and A.Q.; project administration, J.M.-G. and A.Q.; funding acquisition, J.M.-G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was partially funded by Generalitat Valenciana, Spain [grant number GV-2013-087].

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Human Research Ethics Committee of the University of Valencia (protocol code H1380699879808 and date of approval 13 January 2014).

Informed Consent Statement: Informed consent was obtained from the legal guardian/s of the adolescents involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: This research was possible thanks to the collaboration of the schools, their teachers, students and parents.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Poitras, V.J.; Gray, C.E.; Borghese, M.M.; Carson, V.; Chaput, J.-P.; Janssen, I.; Katzmarzyk, P.T.; Pate, R.R.; Gorber, S.C.; Kho, M.E.; et al. Systematic Review of the Relationships between Objectively Measured Physical Activity and Health Indicators in School-Aged Children and Youth. *Appl. Physiol. Nutr. Metab.* **2016**, *41*, S197–S239. [CrossRef] [PubMed]
2. Carson, V.; Tremblay, M.S.; Spence, J.C.; Timmons, B.W.; Janssen, I. The Canadian Sedentary Behaviour Guidelines for the Early Years (Zero to Four Years of Age) and Screen Time among Children from Kingston, Ontario. *Paediatr. Child Health* **2013**, *18*, 25–28. [CrossRef] [PubMed]
3. Guthold, R.; Stevens, G.A.; Riley, L.M.; Bull, F.C. Global Trends in Insufficient Physical Activity among Adolescents: A Pooled Analysis of 298 Population-Based Surveys with 1·6 Million Participants. *Lancet Child Adolesc. Health* **2020**, *4*, 23–35. [CrossRef] [PubMed]
4. Crooks, N.; Alston, L.; Nichols, M.; Bolton, K.; Allender, S.; Fraser, P.; Le, H.; Bliss, J.; Rennie, C.; Orellana, L.; et al. Association between the School Physical Activity Environment, Measured and Self-Reported Student Physical Activity and Active Transport Behaviours in Victoria, Australia. *Int. J. Behav. Nutr. Phys. Act.* **2021**, *18*, 79. [CrossRef] [PubMed]
5. Molina-García, J.; García-Massó, X.; Estevan, I.; Queralt, A. Built Environment, Psychosocial Factors and Active Commuting to School in Adolescents: Clustering a Self-Organizing Map Analysis. *Int. J. Environ. Res. Public Health* **2019**, *16*, 83. [CrossRef]
6. Chillón, P.; Martínez-Gómez, D.; Ortega, F.; Pérez-López, I.; Díaz, L.; Veses, A.; Veiga, O.; Marcos, A.; Delgado-Fernández, M. Six-Year Trend in Active Commuting to School in Spanish Adolescents. *Int. J. Behav. Med.* **2013**, *20*, 529–537. [CrossRef] [PubMed]
7. Dygrýn, J.; Mitáš, J.; Gába, A.; Rubín, L.; Frömel, K. Changes in Active Commuting to School in Czech Adolescents in Different Types of Built Environment across a 10-Year Period. *Int. J. Environ. Res. Public Health* **2015**, *12*, 12988–12998. [CrossRef]
8. Sallis, J.; Floyd, M.; Rodríguez, D.; Saelens, B. Role of Built Environments in Physical Activity, Obesity, and Cardiovascular Disease. *Circulation* **2012**, *125*, 729–737. [CrossRef] [PubMed]
9. Sallis, J.F.; Owen, N.; Fisher, E. Ecological Models of Health Behavior. In *Health Behavior: Theory, Research, and Practice*; Jossey-Bass: San Francisco, CA, USA, 2015; pp. 43–64.
10. Smith, M.; Hosking, J.; Woodward, A.; Witten, K.; MacMillan, A.; Field, A.; Baas, P.; Mackie, H. Systematic Literature Review of Built Environment Effects on Physical Activity and Active Transport—An Update and New Findings on Health Equity. *Int. J. Behav. Nutr. Phys. Act.* **2017**, *14*, 158. [CrossRef]
11. Li, L.; Moosbrugger, M.E. Correlations between Physical Activity Participation and the Environment in Children and Adolescents: A Systematic Review and Meta-Analysis Using Ecological Frameworks. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9080. [CrossRef]
12. Ortegon-Sanchez, A.; McEachan, R.; Albert, A.; Cartwright, C.; Christie, N.; Dhanani, A.; Islam, S.; Ucci, M.; Vaughan, L. Measuring the Built Environment in Studies of Child Health—A Meta-Narrative Review of Associations. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10741. [CrossRef] [PubMed]

13. Brownson, R.; Hoehner, C.; Day, K.; Forsyth, A.; Sallis, J. Measuring the Built Environment for Physical Activity State of the Science. *Am. J. Prev. Med.* **2009**, *36*, S99–S123. [CrossRef] [PubMed]
14. Sallis, J.; Slymen, D.; Conway, T.; Frank, L.; Saelens, B.; Cain, K.; Chapman, J. Income Disparities in Perceived Neighborhood Built and Social Environment Attributes. *Health Place* **2011**, *17*, 1274–1283. [CrossRef]
15. Saelens, B.; Handy, S. Built Environment Correlates of Walking: A Review. *Med. Sci. Sports Exerc.* **2008**, *40*, S550–S566. [CrossRef]
16. Ding, D.; Sallis, J.; Kerr, J.; Lee, S.; Rosenberg, D. Neighborhood Environment and Physical Activity among Youth: A Review. *Am. J. Prev. Med.* **2011**, *41*, 442–455. [CrossRef] [PubMed]
17. Dalton, M.; Longacre, M.; Drake, K.; Gibson, L.; Adachi-Mejia, A.; Swain, K.; Xie, H.; Owens, P. Built Environment Predictors of Active Travel to School among Rural Adolescents. *Am. J. Prev. Med.* **2011**, *40*, 312–319. [CrossRef]
18. Molina-García, J.; Campos, S.; García-Massó, X.; Herrador-Colmenero, M.; Gálvez-Fernández, P.; Molina-Soberanes, D.; Queralt, A.; Chillón, P. Different Neighborhood Walkability Indexes for Active Commuting to School Are Necessary for Urban and Rural Children and Adolescents. *Int. J. Behav. Nutr. Phys. Act.* **2020**, *17*, 124. [CrossRef] [PubMed]
19. Molina-García, J.; Queralt, A.; Adams, M.; Conway, T.; Sallis, J. Neighborhood Built Environment and Socio-Economic Status in Relation to Multiple Health Outcomes in Adolescents. *Prev. Med.* **2017**, *105*, 88–94. [CrossRef]
20. Talen, E.; Koschinsky, J. The Walkable Neighborhood: A Literature Review. *Int. J. Sustain. Land Use Urban Plan.* **2013**, *1*, 42–63. [CrossRef]
21. Bahrainy, H.; Khosravi, H. The Impact of Urban Design Features and Qualities on Walkability and Health in Under-Construction Environments: The Case of Hashtgerd New Town in Iran. *Cities* **2013**, *31*, 17–28. [CrossRef]
22. Galan, A.; Ruiz-Apilanez, B.; Garcia-Camacha, I. Evaluating Microscale Walkability: A Comparative Analysis of Street Audits. *Urban Des. Int.* **2023**. [CrossRef]
23. Boarnet, M.; Forsyth, A.; Day, K.; Oakes, J. The Street Level Built Environment and Physical Activity and Walking: Results of a Predictive Validity Study for the Irvine Minnesota Inventory. *Environ. Behav.* **2011**, *43*, 735–775. [CrossRef]
24. Kurka, J.; Adams, M.; Geremia, C.; Zhu, W.; Cain, K.; Conway, T.; Sallis, J. Comparison of Field and Online Observations for Measuring Land Uses Using the Microscale Audit of Pedestrian Streetscapes (MAPS). *J. Transp. Health* **2016**, *3*, 278–286. [CrossRef]
25. Moudon, A.; Lee, C. Walking and Bicycling: An Evaluation of Environmental Audit Instruments. *Am. J. Health Promot.* **2003**, *18*, 21–37. [CrossRef] [PubMed]
26. Cain, K.; Millstein, R.; Sallis, J.; Conway, T.; Gavand, K.; Frank, L.; Saelens, B.; Geremia, C.; Chapman, J.; Adams, M.; et al. Contribution of Streetscape Audits to Explanation of Physical Activity in Four Age Groups Based on the Microscale Audit of Pedestrian Streetscapes (MAPS). *Soc. Sci. Med.* **2014**, *116*, 82–92. [CrossRef]
27. Sallis, J.; Cain, K.; Conway, T.; Gavand, K.; Millstein, R.; Geremia, C.; Frank, L.; Saelens, B.; Glanz, K.; King, A. Is Your Neighborhood Designed to Support Physical Activity? A Brief Streetscape Audit Tool. *Prev. Chronic Dis.* **2015**, *12*, 150098. [CrossRef] [PubMed]
28. Cain, K.; Geremia, C.; Conway, T.; Frank, L.; Chapman, J.; Fox, E.; Timperio, A.; Veitch, J.; Van Dyck, D.; Verhoeven, H.; et al. Development and Reliability of a Streetscape Observation Instrument for International Use: MAPS-Global. *Int. J. Behav. Nutr. Phys. Act.* **2018**, *15*, 19. [CrossRef]
29. Bauman, A.; Reis, R.; Sallis, J.; Wells, J.; Loos, R.; Martin, B. Lancet Phys Activity Series Workin Correlates of Physical Activity: Why Are Some People Physically Active and Others Not? *Lancet* **2012**, *380*, 258–271. [CrossRef]
30. Vanwolleghem, G.; Ghekiere, A.; Cardon, G.; De Bourdeaudhuij, I.; D'Haese, S.; Geremia, C.; Lenoir, M.; Sallis, J.; Verhoeven, H.; Van Dyck, D. Using an Audit Tool (MAPS Global) to Assess the Characteristics of the Physical Environment Related to Walking for Transport in Youth: Reliability of Belgian Data. *Int. J. Health Geogr.* **2016**, *15*, 41. [CrossRef]
31. Brownson, R.C.; Hoehner, C.M.; Brennan, L.K.; Cook, R.A.; Elliott, M.B.; McMullen, K.M. Reliability of 2 Instruments for Auditing the Environment for Physical Activity. *J. Phys. Act. Health* **2004**, *1*, 191–208. [CrossRef]
32. Kealey, M.; Kruger, J.; Hunter, R.; Ivey, S.; Satariano, W.; Bayles, C.; Ramirez, B.; Bryant, L.; Johnson, C.; Lee, C. Engaging Older Adults to Be More Active Where They Live: Audit Tool Development. *Prev. Chronic Dis.* **2005**, *2*, 1–2.
33. Queralt, A.; Molina-García, J.; Terrón-Pérez, M.; Cerin, E.; Barnett, A.; Timperio, A.; Veitch, J.; Reis, R.; Silva, A.A.P.; Ghekiere, A. Reliability of Streetscape Audits Comparing On-street and Online Observations: MAPS-Global in 5 Countries. *Int. J. Health Geogr.* **2021**, *20*, 6. [CrossRef] [PubMed]
34. Fox, E.; Chapman, J.; Moland, A.; Alfonsin, N.; Frank, L.; Sallis, J.; Conway, T.; Cain, K.; Geremia, C.; Cerin, E.; et al. International Evaluation of the Microscale Audit of Pedestrian Streetscapes (MAPS) Global Instrument: Comparative Assessment between Local and Remote Online Observers. *Int. J. Behav. Nutr. Phys. Act.* **2021**, *18*, 84. [CrossRef] [PubMed]
35. Saito, Y.; Oguma, Y.; Inoue, S.; Breugelmans, R.; Kikuchi, H.; Oka, K.; Okada, S.; Takeda, N.; Cain, K.L.; Sallis, J.F. Inter-Rater Reliability of Streetscape Audits Using Online Observations: Microscale Audit of Pedestrian Streetscapes (MAPS) Global in Japan. *Prev. Med. Rep.* **2022**, *30*, 102043. [CrossRef] [PubMed]
36. Ganzar, L.A.; Burford, K.; Salvo, D.; Spoon, C.; Sallis, J.F.; Hoelscher, D.M. Development, Scoring, and Reliability for the Microscale Audit of Pedestrian Streetscapes for Safe Routes to School (MAPS-SRTS) Instrument. *BMC Public Health* **2024**, *24*, 722. [CrossRef]
37. Sasaki, N.D.; Dalgallo, A.Z.; Leão, A.L.F.; Kanashiro, M. Análise Da Microescala Da Caminhabilidade: Aplicação Do MAPS-Global Em Um Bairro de Baixa Renda de Uma Cidade Média Brasileira. *Rev. Morfol. Urbana* **2022**, *10*, 1–18. [CrossRef]

38. Patch, C.M.; Conway, T.L.; Kerr, J.; Arredondo, E.M.; Levy, S.; Spoon, C.; Butte, K.J.; Sannidhi, D.; Millstein, R.A.; Glorioso, D. Engaging Older Adults as Advocates for Age-Friendly, Walkable Communities: The Senior Change Makers Pilot Study. *Transl. Behav. Med.* **2021**, *11*, 1751–1763. [CrossRef] [PubMed]
39. Millstein, R.A.; Cain, K.L.; Sallis, J.F.; Conway, T.L.; Geremia, C.; Frank, L.D.; Chapman, J.; Van Dyck, D.; Dipzinski, L.R.; Kerr, J.; et al. Development, Scoring, and Reliability of the Microscale Audit of Pedestrian Streetscapes (MAPS). *BMC Public Health* **2013**, *13*, 403. [CrossRef] [PubMed]
40. Trost, S.G.; Loprinzi, P.D.; Moore, R.; Pfeiffer, K.A. Comparison of Accelerometer Cut Points for Predicting Activity Intensity in Youth. *Med. Sci. Sports Exerc.* **2011**, *43*, 1360–1368. [CrossRef]
41. Evenson, K.; Catellier, D.; Gill, K.; Ondrak, K.; McMurray, R. Calibration of Two Objective Measures of Physical Activity for Children. *J. Sports Sci.* **2008**, *26*, 1557–1565. [CrossRef]
42. Norman, G.; Schmid, B.; Sallis, J.; Calfas, K.; Patrick, K. Psychosocial and Environmental Correlates of Adolescent Sedentary Behaviors. *Pediatrics* **2005**, *116*, 908–916. [CrossRef] [PubMed]
43. Rosenberg, D.; Norman, G.; Wagner, N.; Patrick, K.; Calfas, K.; Sallis, J. Reliability and Validity of the Sedentary Behavior Questionnaire (SBQ) for Adults. *J. Phys. Act. Health* **2010**, *7*, 697–705. [CrossRef] [PubMed]
44. Landis, J.; Koch, G. Measurement of Observer Agreement for Categorical Data. *Biometrics* **1977**, *33*, 159–174. [CrossRef] [PubMed]
45. Schielzeth, H.; Dingemanse, N.J.; Nakagawa, S.; Westneat, D.F.; Allegue, H.; Teplitsky, C.; Réale, D.; Dochtermann, N.A.; Garamszegi, L.Z.; Araya-Ajoy, Y.G. Robustness of Linear Mixed-effects Models to Violations of Distributional Assumptions. *Methods Ecol. Evol.* **2020**, *11*, 1141–1152. [CrossRef]
46. Pocock, T.; Moore, A.; Keall, M.; Mandic, S. Physical and Spatial Assessment of School Neighbourhood Built Environments for Active Transport to School in Adolescents from Dunedin (New Zealand). *Health Place* **2019**, *55*, 1–8. [CrossRef] [PubMed]
47. Pizarro, A.; Santos, M.; Ribeiro, J.; Mota, J. Physical Activity and Active Transport Are Predicted by Adolescents' Different Built Environment Perceptions. *J. Public Health* **2012**, *20*, 5–10. [CrossRef]
48. Nelson, N.; Woods, C. Neighborhood Perceptions and Active Commuting to School among Adolescent Boys and Girls. *J. Phys. Act. Health* **2010**, *7*, 257–266. [CrossRef]
49. Sallis, J.; Carlson, J.; Ortega, A.; Allison, M.; Geremia, C.; Sotres-Alvarez, D.; Jankowska, M.; Mooney, S.; Chambers, E.; Hanna, D.; et al. Micro-Scale Pedestrian Streetscapes and Physical Activity in Hispanic/Latino Adults: Results from HCHS/SOL. *Health Place* **2022**, *77*, 102857. [CrossRef]
50. Van Kann, D.; Kremers, S.; Gubbels, J.; Bartelink, N.; de Vries, S.; de Vries, N.; Jansen, M. The Association between the Physical Environment of Primary Schools and Active School Transport. *Environ. Behav.* **2015**, *47*, 418–435. [CrossRef]
51. Phillips, C.B.; Engelberg, J.K.; Geremia, C.M.; Zhu, W.; Kurka, J.M.; Cain, K.L.; Sallis, J.F.; Conway, T.L.; Adams, M.A. Online versus In-Person Comparison of Microscale Audit of Pedestrian Streetscapes (MAPS) Assessments: Reliability of Alternate Methods. *Int. J. Health Geogr.* **2017**, *16*, 27. [CrossRef]
52. Bromm, K.N.; Lang, I.-M.; Twardzik, E.E.; Antonakos, C.L.; Dubowitz, T.; Colabianchi, N. Virtual Audits of the Urban Streetscape: Comparing the Inter-Rater Reliability of GigaPan® to Google Street View. *Int. J. Health Geogr.* **2020**, *19*, 31. [CrossRef] [PubMed]