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Quality of Life in the City of Trikala (Greece): Attitudes and Opinions of Residents on Green Spaces and Cycling Paths

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Abstract: Over recent decades, intense urbanization, city expansion, and unregulated construction have led to a scarcity of green spaces and environmental degradation. Green spaces significantly enhance residents' quality of life by supporting mental and physical health, improving environmental conditions, and benefiting the local microclimate. However, adding green spaces alone is insufficient for modern cities. Increasing population mobility and demand for sustainable transportation modes highlight the role of bicycles and safe bike lane networks in urban development. This study focuses on the perspectives of Trikala's citizens regarding the contributions of green spaces to their quality of life and cycling habits, and to the effectiveness of current cycling infrastructure. Using a structured questionnaire, data were analyzed with SPSS through descriptive and multivariate analysis. The results demonstrate a strong public acknowledgment of green spaces and bicycles as essential components for sustainable urban planning. Nevertheless, challenges with bike lane safety and network continuity were evident. This study concludes that enhancing both green spaces and cycling infrastructure is crucial for fostering a more environmentally friendly and healthy urban environment. Policy recommendations include improving bike lane safety and expanding green space access, creating a foundation for sustainable, resilient urban living.

Keywords: cities; green infrastructure; spatial planning; transport; factor analysis; questionnaires; bicycles

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Citation: Arabatzis, G.; Malesios, C.; Kolkos, G.; Kantartzis, A.; Lemonakis, P. Quality of Life in the City of Trikala (Greece): Attitudes and Opinions of Residents on Green Spaces and Cycling Paths. *Land* **2024**, *13*, 1819. https://doi.org/10.3390/land13111819

Academic Editor: Maria Rosaria Guarini

Received: 3 October 2024
Revised: 28 October 2024
Accepted: 31 October 2024
Published: 2 November 2024

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1. Introduction

In contemporary times, on a global scale, municipalities face both climate change and the challenge of designing resilient cities [1], as these are particularly vulnerable to the impacts of climate change [2]. Due to the urban heat island effect and global climate change, high air temperatures significantly affect public health, especially in urban areas. This makes it more challenging for urban planners and city designers to accommodate the growing urban population and make cities less vulnerable to future climate change [3]. In recent years, there has been an increasing interest in developing strategies for climate change adaptation. The use of vegetation and appropriate urban geometry seem to be very promising solutions for mitigating the adverse effects of the heat island effect, providing a better environment for pedestrians [4].

In recent years, there has been increasing discussion about a policy based on urban mobility, referred to as the "sustainable urban transport system". This system aims to ensure the following: (a) accessibility to jobs and services for all, (b) the rational use of

private cars, (c) the improvement of public health and transport safety, (d) a reduction in pollution, greenhouse gas emissions, and energy consumption (promoting vehicles using renewable or alternative fuels), (e) the increased efficiency and cost-effectiveness of public transportation (with regular schedules and competitive pricing), (f) an increase in the share of non-motorized transport, and (g) the enhancement of the attractiveness and quality of the urban environment [5].

The promotion of soft transportation modes (pedestrian and cycling paths) through urban planning limits vehicle use, which in turn reduces air pollution in urban centers. In modern cities, due to the urgent need to promote so-called sustainable means of transportation and the growing interest in improving the physical health of urban residents, the role of the bicycle over private cars in urban transportation is increasingly being upgraded [6]. The bicycle is a mode of transport widely used across the globe, as it can meet various human needs such as commuting, recreation, and exercise. Today, the number of bicycles worldwide is estimated to exceed one billion. The bicycle is considered a potential solution to the severe transportation issues that characterize most large cities. It is believed that bicycles do not face traffic congestion problems, require minimal parking space, can travel off-road, and do not pollute the environment in any way (emissions, noise pollution). Additionally, considering that it is more economical and, in some cases, faster with more predictable travel times, recreational, and contributes to good physical fitness, the bicycle can become highly competitive for commuting in modern cities [7].

This study provides a unique perspective by examining the intersection of green spaces and cycling infrastructure within the specific urban context of Trikala, Greece. While the benefits of green spaces and alternative transportation modes like cycling have been widely researched in urban studies, the combined impact of these elements on urban mobility and environmental quality in a mid-sized Greek city remains underexplored. By focusing on the residents' views and using a localized methodological approach, this research offers novel insights into how green space integration with cycling infrastructure influences urban sustainability and quality of life in Trikala. The findings of this study highlight the potential for similar cities to utilize green spaces and cycling paths as dual-purpose assets for improving environmental conditions and promoting sustainable urban mobility.

2. Literature Review

Modern cities are complex socio-ecological systems; therefore, the decisions responsible for today's availability of green spaces were made many years ago. For this reason, it is challenging to identify all the factors that influence the quality of urban green infrastructure today. A positive relationship between green infrastructure and the urban environment is crucial for improving the well-being and health of the population. However, in many developed countries, the availability of green spaces is limited, and their distribution within the city may be uneven [8].

A primary goal of spatial planning, particularly urban planning, which typically incorporates land use planning, is to ensure public benefit. This includes the hygiene and esthetics of cities as well as the protection of natural resources within the broader ecosystem in which an urban area is situated. In this context, the provision of critical green infrastructure elements, such as green spaces, open public spaces, and generally, shared public spaces, as well as the regulation and management of private open spaces (e.g., uncovered areas of a plot), have traditionally been key concerns of urban planning [9].

In many countries, urban green spaces are generally a low priority at both national and local levels, with limited funding allocated to them. Additionally, there is an increasing focus on the need for more intensive development in urban areas, centered around the concept of the high-density "compact city" as a model for future cities, particularly in Europe. However, this model raises questions about how and where urban green spaces can be designed. Furthermore, emphasis is also placed on development in areas and locations that have emerged from the deindustrialization of these regions, as well as rail transport

corridors in key central urban areas. There is also an assumption that more intensive urban development may sometimes involve the sacrifice of existing green spaces [10].

Urban green spaces essentially represent the integration of nature into urban areas while simultaneously promoting sustainable development, improving residents' quality of life, and mitigating the environmental impacts of urban living [11]. Despite the numerous benefits that urban green spaces offer, cities and their residents face certain challenges and problems in managing them. One of the main challenges is the limited availability of land for creating green spaces in densely populated and highly urbanized areas. Additionally, the maintenance, protection, and care of green spaces require significant resources, including both human and financial [12]. Furthermore, the existence of green spaces in cities is linked to reducing costs associated with addressing environmental issues, such as water resource management and pollution control [13]. Access to green spaces is a fundamental right for citizens and contributes to the promotion of social justice within a city. It is imperative to ensure equitable access to green spaces for all residents, regardless of their social, economic, or ethnic background. The absence of green spaces in poorer or remote areas can lead to disparities and inequalities in the health and quality of life [14]. Therefore, ensuring equity in access to green spaces is essential for creating a healthy and just urban environment [15].

The development of green infrastructure is an important and ambitious goal of environmental policy in many countries around the world. However, the objectives of green infrastructure may vary, particularly regarding the requirements for its spatial distribution [16]. The availability of urban green spaces in European cities can be directly related to their geographical location. It is observed that a higher number of public green spaces are found in Northern and Central European countries compared to Mediterranean countries. Furthermore, it is acknowledged that the distribution of urban green spaces is linked to the position of different social classes. This means that lower socio-economic segments of society, such as low-income groups or ethnic minorities, often have less access or are deprived of access to green spaces compared to the rest of the population [17].

As the effects of shrinking green spaces in urban centers become evident, local and regional authorities must adopt environmental planning policies that can aid in the creation of new green spaces to ensure a good quality of life for citizens, while simultaneously restoring the natural environment [18]. Additionally, the current need to adapt to climate change demands urgent action from both stakeholders involved in addressing climate change and citizens [19], as green infrastructure is one of the best planning tools for both climate change adaptation and mitigation. The term "green infrastructure" refers essentially to a multifunctional network of environmental and other elements. These elements can be either public or private, pre-existing or newly developed, and cover all spatial scales. The design and management of this network contribute to the sustainability of communities and enhance the local character of urban areas [9].

Urban green spaces, along with their infrastructure, contribute to the enhancement and strengthening of the city's basic unit, the neighborhood, while also fostering broader social cohesion within the city. Urban green spaces provide numerous ecosystem services that could help address various urban issues and improve residents' quality of life, including their health [20]. It is also observed that in urban areas with high-quality green spaces surrounding the built environment, property values tend to rise [21], as their presence enhances the sense of community and attracts new residents [22].

For the proper functioning and sustainability of cities, urban green spaces are essential and highly important because (a) they improve citizens' daily lives by contributing to their recreation and mental health, (b) they mainly help preserve urban biodiversity, (c) they enhance the urban cultural character, (d) they provide spaces and locations where residents can experience and coexist with nature, (e) they maintain and generally improve the urban environment, and (f) they offer natural solutions to urban technical problems [23].

In general, green infrastructure serves as a fundamental and essential foundation for making city living easier, thus contributing to maintaining the balance of both neighborhood

and broader urban ecosystems. Urban green spaces perform a multitude of functions, such as improving air quality, mitigating temperature, and supporting mental and social health, among others, making green infrastructure a prerequisite for sustainable urban planning. However, not all of these functions are necessary in every urban environment, and some are generally more critical. The prioritization of these functions plays a significant role in the design challenges of green infrastructure, due to the involvement of various services, scientists, stakeholders, interests, and priorities [24,25].

In Greek cities, a significant problem is the lack of open urban green spaces, as well as the inability to maintain existing ones, resulting in their degradation and eventual abandonment. This shortage can be attributed to inadequate city plans and ineffective urban planning. The lengthy processes required to conduct studies and implement city plans, along with the inability to secure financial resources from local authorities for the release of land and the creation of green spaces, represent another major challenge [26]. However, the creation of green spaces alone is not enough. In addition to the adverse environmental impacts, the mobility in modern cities is constantly increasing, along with the search for alternative modes of transportation [27]. As a result, the use of bicycles and the development of a safe network of bike lanes contribute to the establishment of sustainable mobility corridors. Essentially, it is imperative to reshape the city's road environment on both traffic and environmental levels [28].

In an effort to improve living conditions in cities, transportation now plays an active role. This includes reducing the use of private cars, opting for public transportation, and, of course, using bicycles. Cycling is a low-cost mode of transportation that provides health benefits while also being environmentally friendly. Any infrastructure that can be used by cyclists is referred to as cycling infrastructure. The sections of the road that are delineated from the roadway and marked for the exclusive use of bicycles are called bike lanes. Bike lanes allow for the safe movement of bicycles within the road network, with cyclists being protected from other vehicles, being able to maintain a steady speed, and enjoying routes without physical obstacles (curbs, etc.) [29].

Bicycles make a valuable contribution to achieving an efficient and sustainable transportation system, helping to alleviate the traffic congestion that plagues cities [30]. In the U.S., municipalities are increasingly introducing bike lanes to promote cycling, enhance road safety, and improve public health. At the same time, efforts are being made to identify specific locations where the creation of bike lanes could more effectively reduce accident rates [31]. Cycling is an environmentally friendly and healthy mode of transportation that can be supported by appropriate infrastructure. In particular, e-bike users demand higher-quality infrastructure compared to regular bike users [32]. Cycling infrastructure near the origin and destination of potential trips can either facilitate cyclists or serve as a potential barrier to encouraging cycling [33]. Recent studies have increasingly focused on finding the best approach to designing optimal bike lane networks [34,35]. Over the past few decades, several national, state, and local policies have influenced the quality and capacity of dedicated cycling infrastructure as well as its spatial planning. Additionally, the use of cars and cyclists' personal safety play crucial roles in increasing bicycle use [36–38].

Cycling can provide significant health benefits for the entire community, such as reducing air and noise pollution. Additionally, cyclists save money by not driving, which allows them to spend more on other things, while cities save on infrastructure costs and can invest those savings elsewhere [39]. Bike lanes emerged alongside the rise of the automobile industry and were initially designed to separate traffic flows, regulate cyclists, and reduce accidents, rather than to facilitate cycling. Specifically, after the interwar period, various cycling organizations opposed bike lanes, simply advocating for improved road surfaces for all users. Today, bike lanes have transformed into symbols of power, health, and bicycle sustainability, with most cities supporting the construction of dedicated bike lanes as a clear path toward sustainable urban mobility [40].

3. Materials and Methods

3.1. Research Area

The research was conducted in the city of Trikala, a medium-sized city (>60,000 inhabitants) by Greek standards. It is a generally flat city, ideal for transportation and commuting by bicycle. Given the city's topography, the bicycle serves as a primary mode of transportation within the urban fabric, making the existence of an organized and continuous network of bike lanes a necessity and a priority. While there are bike lanes in the city, they do not form a continuous network and certainly do not fully meet the needs of the city's residents [41,42]. Trikala is located in central mainland Greece, on the northwestern side of the Thessalian plain. It is the third-largest city in Thessaly by population, with more than 60,000 residents. The location of the research area is presented in Figure 1. Trikala is the administrative center of the Municipality of Trikala and the Regional Unit of the same name. This city is a significant commercial hub and service center, closely linked to agricultural production [43].

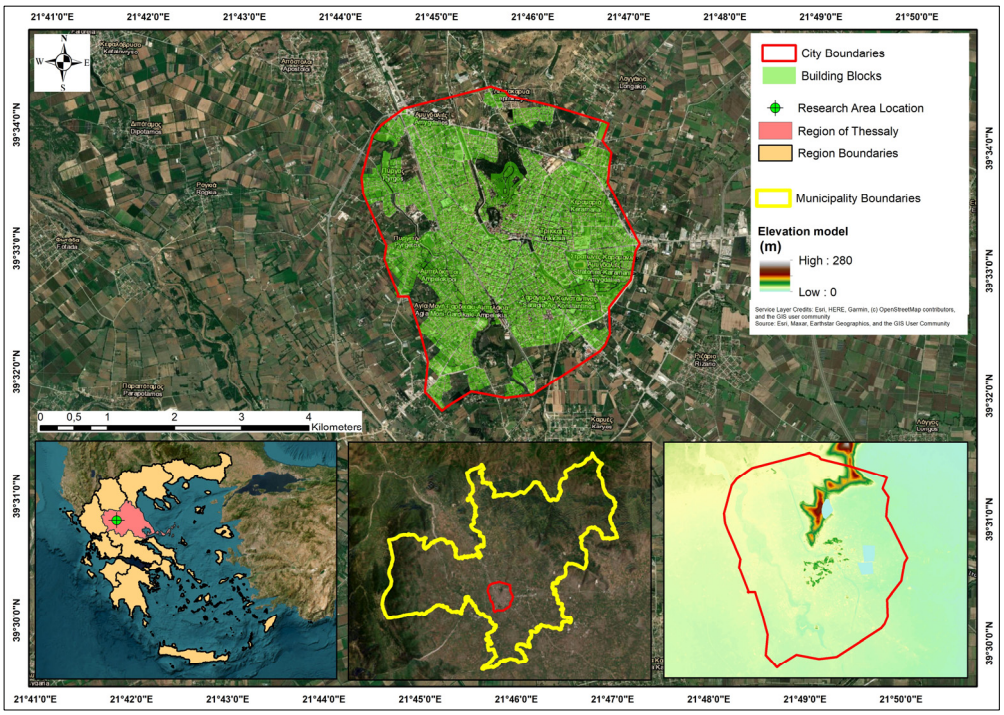


Figure 1. Location of map of research area.

In 1885, the first city plan was drafted, introducing the concept of the public square for the first time. The second city plan was prepared in 1937 (Greek Government Gazette 314/Issue A/1937) but was implemented twenty years later due to World War II and the Greek Civil War. In 1987, a new general urban plan was developed, dividing the city into thirteen (13) urban units, referred to as neighborhoods, districts, or 4-degree communities. The city is characterized by its size, dominated by concrete, tall, and bulky buildings, dense construction, numerous roads, and vehicles, at the expense of outdoor planning. Urban green spaces are limited to the city center, present in squares, along the banks of the Lithaios River, in tree-lined streets, on the hills of "Frourio" and "Profitis Ilias", and in parks such as "Ai Giorgis", "Matsopoulos", the "Zoological Garden", "Analepsis Hill", and "Rizoma" [44]. In the decades following World War II, the prevailing perception of development by the state and society was aligned with economic growth. This one-dimensional view of development was also reflected spatially, shaping the modern city of Trikala. The city expanded and the building coefficients and maximum permissible building heights increased, with the sole objective being the pursuit of greater profit from property exploitation. This new perception of urban development, combined with the

major earthquake of 1954, destroyed a significant part of the city's old architectural heritage, which was replaced by modern buildings, most of them multi-story, primarily built through the system of property exchange [43].

3.2. Methodology

The implementation of an empirical study in the social sciences passes through various phases or stages. One of these phases is data collection, particularly the collection of individual and social data with the help of a questionnaire [45]. The questionnaire used in this research included primarily closed-ended questions. The full questionnaire, which included detailed questions on green space perceptions, cycling behaviors, and transportation attitudes, is available upon request to the corresponding author. Therefore, the research was conducted using a structured questionnaire, and the method of personal interviews was employed. Interviews are the best way to collect statistical data and are widely used in sample surveys [46]. Simple random sampling was used as the sampling method due to its simplicity and the fact that it requires the least amount of knowledge about the population compared to other methods [47,48].

In this study, a methodology similar to that used in previous social research was employed [49,50]. The sample size consisted of 385 individuals. Data collection took place during the period of 2023–2024, and the data were analyzed using descriptive statistics, factor analysis [51], and a binary logistic regression modeling approach [52]. The statistical software used was IBM SPSS Statistics version 27.0 [53]. A binary logistic regression modeling approach [52] was applied to examine the potential predictors of bicycle use for commuting, as measured by the structured questionnaire (dichotomous variable: 1: no; 2: yes). Specifically, a total of eight independent variables from the questionnaire were utilized as predictors. A detailed description of the dependent variables used is provided in Table 1.

Table 1. Variables utilized as predictors in the logistic regression model.

Variable	Description	Description
Q32	Do you consider the existing network of cycle paths in your municipality safe and organized?	1: No 2: Yes
Q33	Have you used any of the road axes of the existing cycling network?	1: No 2: Yes
Q34	The problems you encountered were mainly:	1: Pedestrian crossing 2: Incomplete marking 3: Vehicles inside the cycle lane 4: Malfunctions 5: Difficulty crossing intersections
Q35	Do you think that the existing network favors the use of bicycles in your municipality?	1: No 2: Yes
Q41	In which of the following categories do you fall in terms of your grammar knowledge?	1: I haven't finished primary school 2: Elementary 3: High school 4: High school, Secondary technical school diploma 5: Technical University 6: University 7: Postgraduate 8: Ph.D

Table 1. *Cont.*

Variable	Description	Description
Q42	In which of the following categories do you belong in terms of your professional status?	1: Farmer 2: Livestock breeder 3: Household 4: Private employee 5: Public servant 6: Self-employed (tradesman, plumber, electrician, etc.) 7: Self-employed (doctor, lawyer, engineer, etc.) 8: Craftsman/entrepreneur 9: Worker 10: Student
Q43	Are you a member of any club (cycling, physical, etc.)?	1: No 2: Yes
Q44	If you wish, we would like you to tell us your net annual income?	1: <5000 euros 2: 5001–10,000 euros 3: 10,001–15,000 euros 4: 15,001–20,000 euros 5: 20,001–25,000 euros 6: 25,001–30,000 euros 7: >30,000 euros

For modeling the dichotomous categorical responses on the question of interest, it is assumed that the dependent variable $y_i = (y_1, y_2)^t$, follows the binomial distribution and is linked to a set of m = 8 predictor variables $\left\{x_1, x_2, ..., x_{\updownarrow}, ..., x_m\right\}$ via the following equation:

$$log\left(\frac{p_i}{p_{i^*}}\right) = \beta^T X + \varepsilon, \quad (1)$$

where p_i denotes the probability of answer category i = "no", whereas p_{i^*} is the reference category of the response variable (response = "yes"), with X being the matrix of covariates; β is the vector of parameter estimates corresponding to X and finally ε is the error term, which is assumed to follow the Normal distribution with zero mean and constant variance σ^2, i.e., $\varepsilon \sim N(0, \sigma^2)$.

In order to estimate the regression model parameters, the maximum likelihood method was utilized, and the best-fitted model, which includes only statistically significant explanatory variables, was selected using a backward stepwise selection technique. The model's goodness-of-fit was assessed using Deviance and various pseudo-R^2 statistics (i.e., Cox and Snell R Square, Nagelkerke R Square) [54,55]. The models with lower values in these statistics indicate a better fit.

The collected data were imported and analyzed using SPSS Statistical Software, version 20.0 (IBM Corp., released 2020).

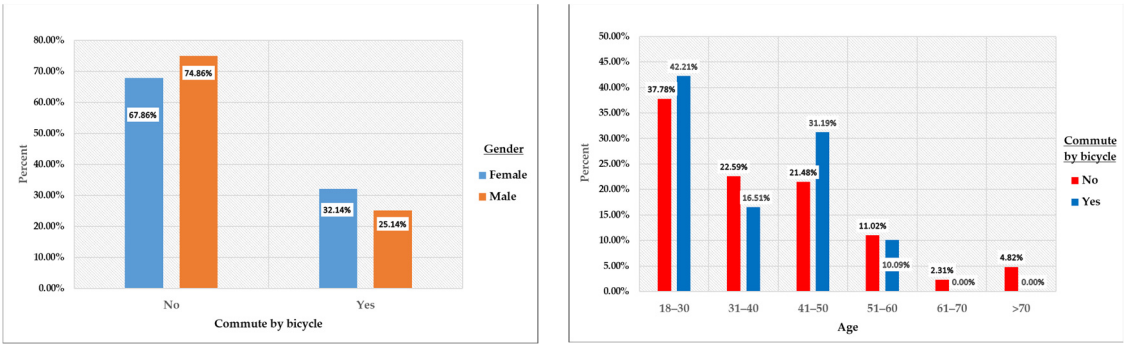
Next, exploratory factor analysis (EFA) was applied to a question: "In your opinion, to what extent do urban green spaces contribute to the following?" Specifically, EFA was conducted on 16 items from the questionnaire, which represented potential answers to this question. The results provided were conducted on a set of variables related to the perceived contributions of urban green spaces. EFA was used to identify the underlying relationships between measured variables and to group them into factors, which are sets of variables that correlate highly with each other.

4. Results

4.1. Descriptive Statistics

Based on Figure 2a, it was observed that a higher percentage of female respondents commute by bicycle compared to their male counterparts, with 32.14% of females using a

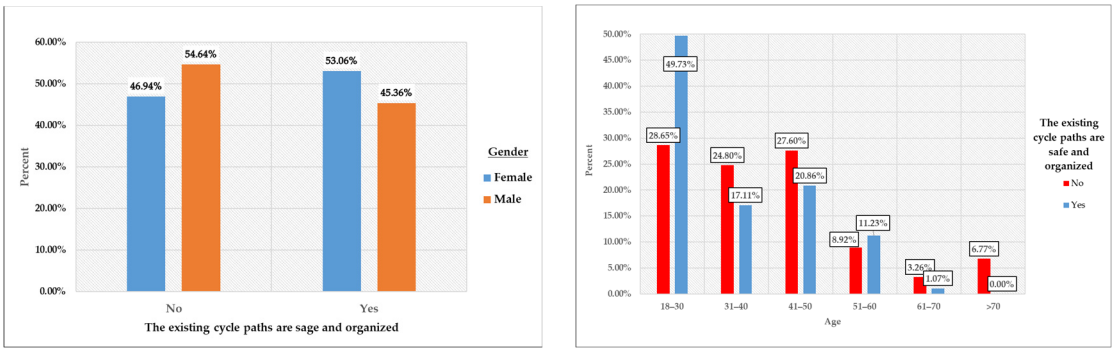
bicycle, compared to 25.14% of males. Conversely, a greater percentage of males (74.86%) reported not commuting by bicycle, in contrast to 67.86% of females, indicating a gender difference in cycling habits for commuting purposes. From Figure 2b, the data show a clear pattern regarding age and bicycle commuting. The respondents in the 18–30 age group (42.21%) and those between 41 and 50 years old (31.19%) commuted more frequently by bicycle than other age groups. In comparison, respondents aged 31–40 and those over 50 showed a significantly lower tendency to use bicycles for commuting, with the lowest rates observed among the 61–70 age group (2.13%) and those over 70 years (0%). This suggests that bicycle commuting is more common among younger and middle-aged respondents, while it decreases sharply for older age groups.



(**a**) (**b**)

Figure 2. (**a**) Percentage of use of a bicycle to commute by gender; (**b**) percentage of use of a bicycle to commute by age.

From Figure 3a, it is evident that female respondents are more likely to view the existing network of cycle paths in their municipality as safe and organized. Specifically, 53.06% of females responded positively, compared to 45.36% of males. This indicates a gender difference in the perception of the quality and safety of the cycling infrastructure. As seen in Figure 3b, we observed the segmentation of responses by age group. Younger respondents, particularly those aged 18–30, were more supportive of the current cycle path network, with 49.73% expressing a positive view. In contrast, older age groups, especially those over 50, were generally less satisfied with the safety and organization of the network. For example, only 11.23% of the respondents aged 51–60 and 1.07% of those aged 61–70 expressed positive views. This suggests that the perceptions of the cycling infrastructure's safety and organization decline significantly with age.



(**a**) (**b**)

Figure 3. (**a**) Percentage of those considering the existing network of cycle paths in their municipality safe and organized by gender; (**b**) percentage of those considering the existing network of cycle paths in their municipality safe and organized by age.

Descriptive statistics on the responses on the dependent variable in the logistic regression model are presented in the pie chart in Figure 4. The majority of the respondents (71.24%) were not cycling, with only the 28.76% answering that they use a bicycle to commute.

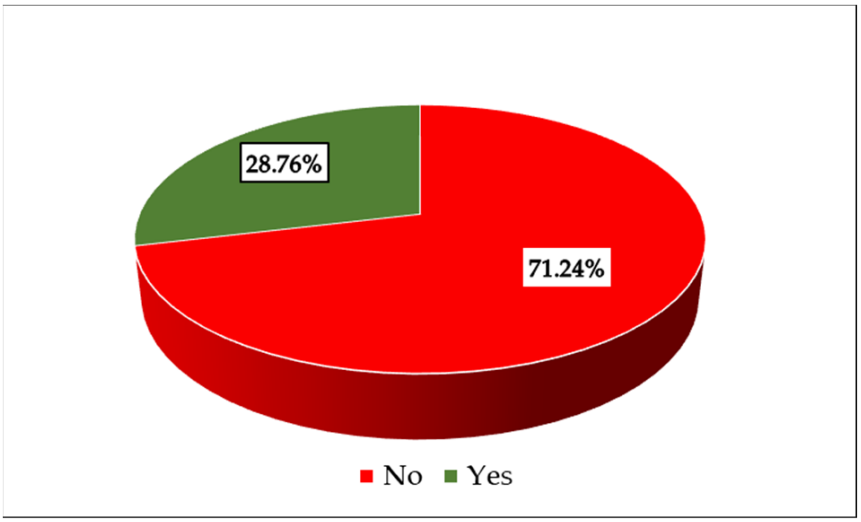


Figure 4. Percentages in responses regarding the use of cycling for commuting.

The descriptive statistics on the sample demographics are presented across three key categories: gender, age, and education level (Figure 5). From Figure 5a, it is observed that the gender distribution of the sample is fairly balanced, with females representing 51.78% of the respondents, while males account for 48.28%. This indicates a near-equal representation of both genders in the study. Figure 5b provides the age distribution of the sample. The largest age group fell between 18 and 30 years old, representing 39.05% of the respondents. The next significant groups were those aged 41–50 (24.27%) and 31–40 (20.84%). Notably, participation decreased significantly for those aged 51 and above, with the 61–70 age group accounting for only 2.12% and those over 70 representing 3.43%. Figure 5c illustrates the educational background of the respondents. The majority, 59.37%, held a university degree, while 11.87% have obtained a master's degree. Additionally, 15.57% of the participants have completed high school or secondary technical school, with smaller proportions holding a PhD (5.28%) or having attended technical university (4.22%). These data indicate a highly educated sample overall, with minimal representation of those with only an elementary education or without a primary school diploma.

Descriptive statistics on the items of the question, "In your opinion, to what extent do urban green spaces contribute to the following?", are presented in Table 2. The respondents believed that the highest contributions of urban green spaces are mostly on the improvement of the quality of life in general (mean response: 4.33; standard deviation: 0.783), followed by their contribution on the microclimate (mean response: 3.95; standard deviation: 0.878), their contribution in developing environmental/ecological/cultural sensitivity (mean response: 3.99; standard deviation: 0.893) and their contribution to the reduction in atmospheric pollution (mean response: 3.91; standard deviation: 1.053).

Upon fitting the model and performing a backward elimination stepwise model selection, we obtained the parameter estimates presented in Table 3. Along with the parameter estimates (b) of the regression coefficients β, the corresponding significances (*p*-value) and odds ratios are also included.

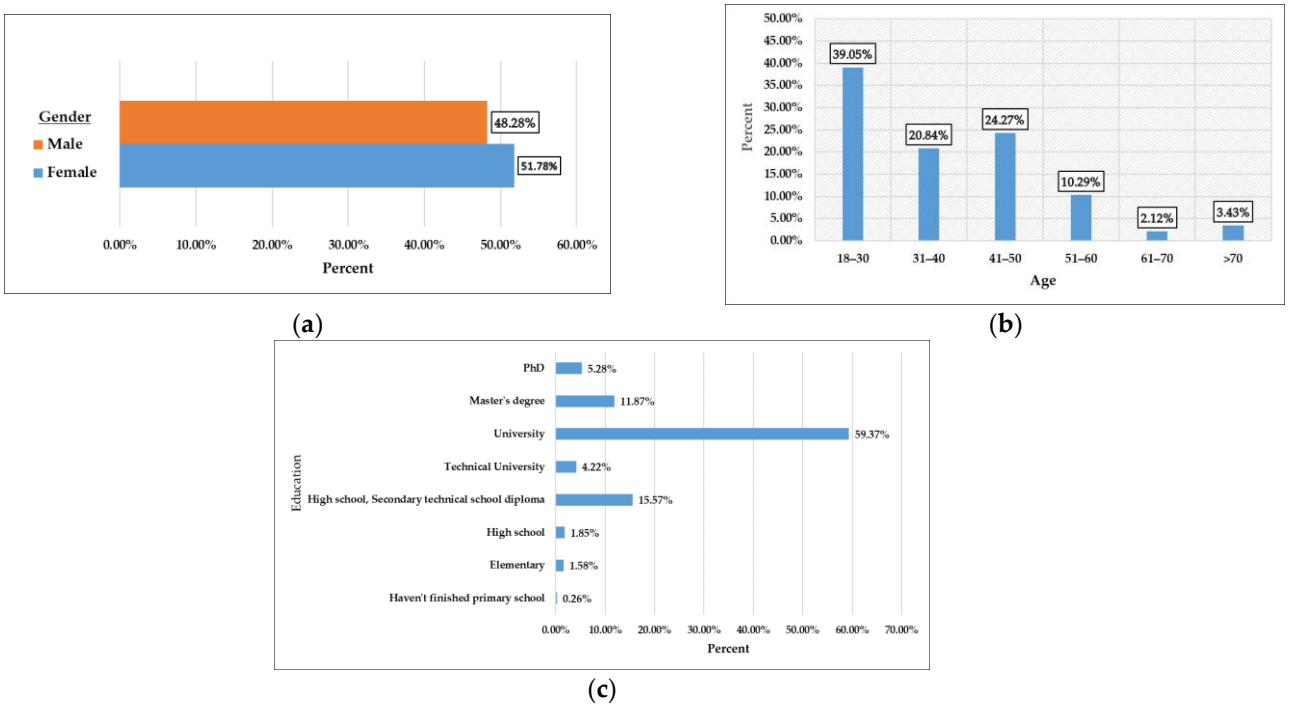


Figure 5. Percentages for sample demographic information (**a**) gender, (**b**) age, (**c**) educational level.

Table 2. Descriptive statistics on the 16 items of the question, "In your opinion, to what extent do urban green spaces contribute to the following?".

Item	Minimum	Maximum	Mean	Std. Deviation
1. They contribute to the reduction of atmospheric pollution	1	5	3.91	1.053
2. They have a positive effect on the microclimate	2	5	3.95	0.878
3. They protect and increase biodiversity	1	5	3.50	0.916
4. They improve the quality of life of the residents	2	5	4.33	0.783
5. Contribute to noise reduction	1	5	3.22	1.151
6. Contribute to the promotion of places of special interest (historical-cultural monuments and attractions)	1	5	3.75	0.791
7. They increase the value of the land	1	5	3.78	0.910
8. They improve the economic development of local communities	1	5	3.07	0.868
9. Contribute to the reduction of natural disasters (e.g., floods)	1	5	3.85	1.047
10. Contribute to the reduction of carbon dioxide emissions	1	5	3.80	1.199
11. They contribute to the better functioning of the hydrological cycle	1	5	3.65	1.038

Table 2. *Cont.*

Item	Minimum	Maximum	Mean	Std. Deviation
12. Contribute to the creation of urban habitats	1	5	3.79	0.997
13. They improve ecosystem services	1	5	3.56	0.923
14. They contribute to sustainable urban mobility	1	5	3.39	0.874
15. They are a means of developing environmental/ecological/cultural sensitivity.	1	5	3.99	0.893
16. They are a pole of attraction for tourist activity	1	5	3.81	1.065

Table 3. Parameter estimates along with *p*-values and OR for the statistically significant predictors.

Variable	b	df	*p*-Value [1]	Odds Ratio (OR)
Constant	−40.678	1	n.s.	0.000
Q34 (ref. category: difficulty crossing intersections)				
Q34: Pedestrian crossing	−2.339	1	0.001 ***	0.096
Q34: Incomplete marking	2.164	1	0.025 **	8.702
Q34: Vehicles inside the cycle lane	−1.452	1	0.087 *	0.234
Q34: Malfunctions	−4.481	1	<0.001 ***	0.011
Q41 (Ref. category: Ph.D)				
Q41: Haven't finished primary school	12.294	1	0.002 ***	483.217
Q41: Elementary	−2.430	1	n.s.	0.088
Q41: High school	−2.473	1	n.s.	0.872
Q41: High school, secondary technical school diploma	−0.813	1	n.s.	0.443
Q41: Technical university	−1.974	1	n.s.	0.139
Q41: University	−3.805	1	0.007 ***	0.022
Q41: Master's degree	−2.344	1	0.093 *	0.096

[1] Parameter is significant at the *** 1% significant level; ** 5% significant level; * 10% significant level; n.s.: Non-statistically significant predictor.

The goodness-of-fit of the final selected model based on a backward elimination procedure was measured through the Deviance, which takes the value of 290.97. The latter, when compared to the Deviance of the null model, including only the constant term (315.45), indicated a significant reduction, hence the final selected predictors were important for the use of a bicycle to commute. The Cox and Snell R Square and Nagelkerke R Square were 0.536 and 0.767, respectively, also indicating a moderate to good fit.

According to the parameter estimates and the results of the final best logistic regression model (Table 3), it is seen that only the "problems encountered" explanatory variable (Q34) and the demographic variable of educational level (Q41) were statistically significant predictors of the choice of using a bicycle to commute.

Specifically, it was found that those who were having difficulties in cycling due to incomplete marking had a higher chance of not cycling, when compared to all the other categories (b = 2.164; *p*-value = 0.025 < 0.05). Those in this category had an approximately 8.7 higher probability of not cycling, compared to cycling.

On the other hand, those encountering problems in cycling, such as a malfunction, were much more probable to cycle for commuting (b = −4.481, *p*-value < 0.001, OR = 0.011) in comparison to those encountering problems such as crossing intersections. The same

holds for those having problems such as pedestrian crossing (b = −2.339, *p*-value < 0.001, OR = 0.096) and encountering vehicles inside the cycle lane (b = −1.452, *p*-value = 0.087 < 0.1, OR = 0.234).

As regards the predictor of educational level, a higher probability of not cycling (~483 more probable to not cycling to commute) was seen for those not finished primary school (b = 12.294; *p*-value = 0.002 < 0.01; OR = 483.217). Reversely, a higher probability for cycling to commute was observed for university graduates (b = −3.805; *p*-value = 0.007 < 0.01; OR = 0.022) and master's degree graduates (b = −2.344; *p*-value = 0.093 < 0.1; OR = 0.096).

4.2. Factor Analysis

4.2.1. Exploratory Factor Analysis

A factor analysis was applied on the question, "In your opinion, to what extent do urban green spaces contribute to the following?".

Specifically, an exploratory factor analysis (EFA) had been conducted on the items of the questionnaire that were possible answers to the above question. The results provided were conducted on a set of variables related to the perceived contributions of urban green spaces. EFA was used to identify the underlying relationships between measured variables and to group them into factors, which are sets of variables that correlate highly with each other.

As regards the exploratory factor analysis conducted on the 16 items from the questionnaire, we had run two factor analyses, utilizing two and three factors. The selection of the latter was based upon various criteria for choosing factor numbers, such as the eigenvalue criterion and the scree plot. The results of factor analysis are summarized in the following tables.

4.2.2. Two-Factor Solution

In this solution, the variables were grouped into two factors (see Table 4 below). Based upon these results, we identified two factors. The first factor may be interpreted as the factor of "Environmental and Ecosystem Benefits". This factor seemed to encompass variables related to environmental improvements and ecosystem services, such as the reduction in atmospheric pollution and noise reduction, and the contribution to carbon dioxide reduction, among others. The loadings were particularly strong for contributions to reducing carbon dioxide emissions and better functioning of the hydrological cycle.

Table 4. Factor loadings of the two-factor solution model.

Item	Factor	
	1	**2**
1. They contribute to the reduction of atmospheric pollution	0.619	
2. They have a positive effect on the microclimate	0.588	
3. They protect and increase biodiversity		0.632
4. They improve the quality of life of the residents	0.518	
5. Contribute to noise reduction	0.539	
6. Contribute to the promotion of places of special interest (historical-cultural monuments and attractions)		0.652
7. They increase the value of the land		0.542
8. They improve the economic development of local communities		0.539
9. Contribute to the reduction of natural disasters (e.g., floods)	0.592	

Table 4. *Cont.*

Item	Factor	
	1	**2**
10. Contribute to the reduction of carbon dioxide emissions	0.921	
11. They contribute to the better functioning of the hydrological cycle	0.879	
12. Contribute to the creation of urban habitats	0.529	
13. They improve ecosystem services		0.584
14. They contribute to sustainable urban mobility	0.451	
15. They are a means of developing environmental/ecological/cultural sensitivity.	0.422	
16. They are a pole of attraction for tourist activity	0.402	

The second factor included aspects related to socio-economic and cultural benefits, like increasing the value of land, promoting places of special interest, and improving local economic development, and therefore could be seen as the factor of "Socio-Cultural and Economic Benefits". This suggests that these aspects of urban green spaces were perceived as distinct from their environmental benefits.

4.2.3. Three-Factor Solution

The three-factor solution differentiated the factors further, introducing a new grouping (see Table 5 below). Here, the first factor remained focused on environmental benefits ("Environmental Benefits" factor), with strong loadings on pollution reduction, carbon dioxide emission reduction, and the hydrological cycle. The second factor appeared to concentrate on biodiversity and broader ecosystem services, and thus could be seen as the "Biodiversity and Ecosystem Services" factor. This included the protection and increase in biodiversity and the improvement of ecosystem services. Finally, the third factor included the socio-economic and cultural impacts, such as promoting places of interest, improving local economic development, and enhancing the quality of life. This separation suggests that the respondents distinguished between different types of benefits provided by urban green spaces. We can therefore describe this factor as the "Socio-Economic and Cultural Benefits" factor.

Table 5. Factor loadings of the three-factor solution model.

Item	Factor		
	1	**2**	**3**
1. They contribute to the reduction of atmospheric pollution		0.826	
2. They have a positive effect on the microclimate		0.748	
3. They protect and increase biodiversity		0.582	
4. They improve the quality of life of the residents		0.527	
5. Contribute to noise reduction	0.463		
6. Contribute to the promotion of places of special interest (historical-cultural monuments and attractions)			0.600
7. They increase the value of the land			0.421
8. They improve the economic development of local communities			0.555
9. Contribute to the reduction of natural disasters (e.g., floods)		0.459	

Table 5. *Cont.*

Item	Factor		
	1	2	3
10. Contribute to the reduction of carbon dioxide emissions	0.800		
11. They contribute to the better functioning of the hydrological cycle	0.798		
12. Contribute to the creation of urban habitats	0.516		
13. They improve ecosystem services			0.644
14. They contribute to sustainable urban mobility	0.522		
15. They are a means of developing environmental/ecological/cultural sensitivity.	0.473		
16. They are a pole of attraction for tourist activity			0.331

5. Discussion

The results of this study offer valuable insights into the perceptions of Trikala's citizens regarding urban green spaces and cycling infrastructure. The findings highlight a strong recognition of the importance of green spaces for the quality of life and environmental health, aligning with previous research on the benefits of urban green infrastructure [12,17]. Specifically, the data suggest that urban green spaces are seen not only as esthetic and recreational assets but also as critical for improving the microclimate and contributing to environmental sustainability, which resonates with the work of Zerva et al. (2018) [19].

The high mean score for the contribution of green spaces to the quality of life (mean: 4.33, SD: 0.783) indicates widespread agreement on their positive impact, supporting the assertion that equitable access to green spaces is essential for urban social justice [56]. However, the relatively lower scores in areas such as noise reduction (mean: 3.22) and economic development (mean: 3.07) suggest potential gaps in public perception on the actual performance of green spaces in addressing these issues. This finding contrasts with studies that emphasize the economic and social value of green spaces [57,58], indicating that further investment in or improved communication about the multifaceted benefits of green spaces might be necessary to fully realize their potential in Trikala.

This study's analysis of cycling behavior revealed a gender and age disparity in bicycle commuting, with younger respondents and women more likely to use bicycles, as seen in Figure 2a,b. This result is consistent with findings from previous research [59,60] that indicate demographic differences in cycling habits. Additionally, the logistic regression analysis showed that perceptions of safety (incomplete cycle path markings and other obstacles) were significant predictors of bicycle use. These barriers, particularly the presence of vehicles in cycle lanes, align with challenges, where inadequate cycling infrastructure negatively impacts cycling rates [61,62]. Despite these barriers, it is encouraging that the respondents recognized the role of bicycles in promoting sustainable urban mobility (mean: 3.39), indicating public support for expanding and improving bike lanes. This aligns with global trends toward enhancing cycling infrastructure as part of broader sustainable transport initiatives.

The factor analysis identified distinct dimensions of public perception related to the benefits of green spaces, splitting into environmental/ecosystem benefits and socio-economic/cultural benefits. This differentiation suggests that urban planners and policymakers in Trikala can tailor strategies based on the specific value that citizens place on these green spaces. The findings imply that an integrated approach, which balances environmental sustainability with social equity and economic development, is essential for maximizing the benefits of green spaces in urban planning [9].

Moreover, given the gender and age disparities in cycling behavior, it is critical to prioritize the development of safer and more accessible cycling infrastructure. By doing so, Trikala can promote inclusive mobility, in line with broader European efforts to increase

non-motorized transport [36]. The city's relatively flat topography makes it ideal for cycling, but the lack of a continuous and safe cycling network, as noted by the participants, suggests that more effort is needed to expand and enhance the existing infrastructure.

The relationship between the exploratory factor analysis (EFA) and the two- and three-factor solutions illustrates a progressive refinement in the interpretation of the data regarding public perceptions of green spaces. The initial EFA provided insight into general clusters of attitudes, guiding the subsequent analysis toward the two-factor solution, which identified distinct groupings focused on "Environmental and Ecosystem Benefits" and "Socio-Cultural and Economic Benefits". This solution revealed a dichotomy between perceptions related to the natural environment versus social and economic dimensions. Moving to the three-factor solution allowed for a more nuanced categorization, isolating "Biodiversity and Ecosystem Services" as a separate factor from broader environmental benefits, while the "Socio-Cultural and Economic Benefits" remained consistent. This layered approach suggests that while citizens recognize the multifaceted roles of green spaces, they distinctly separate ecosystem services (e.g., biodiversity) from both general environmental and socio-economic benefits, providing a clearer basis for tailored urban planning strategies.

The findings of this study contribute to a holistic approach to sustainable urban planning, emphasizing that sustainability in transportation and urban development must go beyond environmental considerations. While environmental benefits, including pollution reduction and resource conservation, are pivotal, true sustainability requires an integrative perspective that also encompasses social and economic dimensions. For instance, expanding green spaces and cycling infrastructure can foster not only environmental health but also enhance social equity by providing accessible, safe, and affordable mobility options. Additionally, such developments can spur local economic growth through increased property values and business opportunities around green and bike-friendly areas. A comprehensive sustainable strategy in urban planning should therefore strive to balance these environmental, social, and economic factors to achieve long-lasting benefits for urban quality of life.

Future studies could build on this research by conducting a more detailed analysis of the socio-economic factors influencing perceptions of green spaces and cycling infrastructure. Additionally, the application of Confirmatory Factor Analysis (CFA) could validate the factor structures identified here and provide more robust insights into the relationship between environmental, social, and economic benefits of green infrastructure. Furthermore, longitudinal studies tracking changes in cycling behavior and green space usage as infrastructure improvements are implemented would be valuable for assessing the long-term impact of urban planning interventions.

Finally, as a limitation of the current research, we should note that while this study primarily addressed the environmental and health benefits of bicycle use and urban green spaces, we acknowledge that a comprehensive approach to sustainable transportation requires an understanding of broader social and economic impacts. An increase in bicycle use may affect public transportation systems by potentially reducing ridership, which can create financial strain on these systems, leading to fare increases. Such changes can disproportionately impact low-income populations who rely heavily on affordable public transit options. Future research could examine these issues by investigating the interplay between bicycle use and public transportation in different urban contexts. This approach would help to ensure that sustainable transportation solutions serve all members of society without creating additional barriers.

6. Conclusions

Densely built areas in city centers are often highly degraded in terms of urban environmental quality, both in terms of microclimate and the building stock, which negatively impacts the urban environment. In particular, in Greek cities, urban public spaces are limited. The insufficient presence of such spaces in cities, combined with multiple environ-

mental problems, has contributed to the extensive pollution of the urban environment and the overall degradation of the urban landscape. In the centers of Greek cities, the creation of new public outdoor spaces and green areas has long been a pressing need for improving the quality of life for residents.

Urban environmental planning encompasses a wide range of strategies and practices aimed at creating sustainable, livable, and resilient urban areas, thereby contributing to the improvement of residents' quality of life. Specifically, it involves the careful consideration of various factors that contribute to the health and well-being of urban populations, as well as the protection and enhancement of the natural environment. Essentially, it is a process of designing and managing the development of urban areas in a way that promotes environmental sustainability, economic growth, and social equity.

The bicycle is a means of transportation that can contribute to sustainable urban planning. In addition to being a reliable mode of transportation within the city, it also serves as a tool for developing a new urban culture. Moreover, it represents a gentler form of mobility, second only to walking, as it is silent (reducing noise pollution) and does not require fuel, thus not polluting the environment while also reducing traffic congestion. Therefore, the use of bicycles and the creation of a safe network of bike lanes can contribute to the development of sustainable mobility corridors for citizens and residents in general, thereby reshaping the city's road environment both in terms of traffic and environmental impact.

Green urban infrastructure, and particularly urban green spaces, are considered key elements for improving quality of life and creating the necessary framework for sustainable cities. Ecosystem services are gaining increasing recognition in urban and planning policies as a crucial component for achieving sustainable cities. The presence of natural urban areas contributes to the quality of life in numerous ways, and this is now being acknowledged by urban planners and city developers.

Author Contributions: Conceptualization, G.A., C.M. and G.K.; methodology, C.M.; software, C.M. and G.K.; validation, G.A., C.M. and G.K.; formal analysis, C.M. and A.K.; investigation, C.M. and P.L.; resources, C.M. and G.K.; data curation, A.K. and P.L.; writing—original draft preparation, G.K.; writing—review and editing, G.K.; visualization, G.K.; supervision, G.A.; project administration, G.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Acknowledgments: The authors would like to express their sincere gratitude to all the citizens of the city of Trikala who generously participated in this research.

Conflicts of Interest: The authors declare no conflicts of interest.

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