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Original article

BEHAVIORS, ATTITUDES, MOTIVATION AND REASON FOR CYCLING IN SKOPJE, NORTH MACEDONIA

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Abstract

Introduction: Cycling is an effective way to incorporate physical activity into daily life. Despite its potential to promote health and well-being, cycling in the Republic of North Macedonia, particularly in Skopje, remains insufficiently supported. The aim of this study was to investigate cycling behaviors, motivations, barriers, and route preferences among residents of Skopje, and to identify factors influencing cycling frequency and route choice.

Materials and methods: An online survey involving 1,169 participants who regularly cycled for different purposes was conducted using a 35-item Google Forms questionnaire. Data were analyzed using SPSS 16.0, and associations between nominal variables were evaluated using Chi-square tests ($p < 0.05$).

Results: Most participants (77.1%) cycled 4–7 times per week, primarily between 7:00 AM and 6:00 PM, with peak activity during May and June. The mean cycling distance per trip was 8.9 km, while the mean commuting distance was 5.6 km. Recreation (76.1%) and commuting to work (70%) were the most common cycling purposes. Speed (79.3%) and perceived health benefits (78.9%) were the leading motivations, whereas adverse weather conditions (79.4%), insufficient cycling infrastructure (42.7%), and air pollution (36.3%) were the main barriers. Availability of dedicated bike lanes strongly influenced route choice (54%).

Conclusion: Cycling in Skopje is currently sustained primarily by an active and motivated subgroup of cyclists. Improving cycling infrastructure, environmental conditions, and institutional support may contribute to broader participation and support cycling as a more sustainable mode of urban transport.

Keywords: cycling, behaviors, attitudes, Skopje, North Macedonia

Introduction

Regular physical activity, including cycling, is associated with improved cardiorespiratory fitness, muscular strength, body composition, bone health, and multiple cardiovascular and metabolic health outcomes. In adults, there is robust proof that physical activity decreases the hazard of early death, coronary heart disease, diabetes mellitus type-2, high blood pressure, detrimental blood lipid profiles, metabolic syndrome, and colon and breast

cancer. Furthermore, it reduces weight gain, promotes weight loss when combined with a healthy diet, prevents the onset of chronic conditions, alleviates depression, and enhances cognitive function in older adults[1].

Although cycling can be done for sport, leisure, commuting, active transportation, and everyday chores like school runs or shopping, it is unclear which specific health advantages come with each of these uses. Cycling is becoming an increasingly significant part of public health guidelines and active transport policies[2].

In addition to environmental barriers, various factors ranging from personal to policy contexts significantly influence cycling behavior. The systematic review by Götschi *et al*.[3], which included 21 observational studies, reported that significant environmental barriers to cycling include perceived and actual traffic dangers, the distance from cycling lanes, long travel distances, steep inclines, and the high level of effort required. High population density, low trip durations, traffic separation, and designated bike routes are all important elements that encourage cycling. Numerous strategies are proposed in the literature to persuade vehicle owners to ride their bikes more. An increase in bikers may result in better safety perceptions and political backing for enhanced cycling infrastructure, which would fuel further increases in cycling participation.

Multiple levels of factors, ranging from individual characteristics to broader environmental and policy contexts, influence cycling. Demographic characteristics like gender and personal perceptions, such as comfort with cycling, play a significant role in cycling behavior. Social support, social norms and the built and natural environments, including infrastructure and terrain, are key contributors to the decision to cycle. Analyzing cycling through an ecological model provides a holistic understanding of the diverse influences that affect cycling behavior[4]. Understanding these factors on a broader scale provides insight into local cycling behaviors, particularly in regions like Skopje. In Macedonia, the automobile is the predominant mode of transportation. More than 35% of the working population aged 15 and older commute to work or school by car. Approximately 20% walk, while 7% take a city bus, 2.6% use an intercity bus, and mere 2.3% ride a bicycle[5].

According to a 2011 study on the traffic system in Skopje, cycling as a mode of transportation has been declining. In 1981, bicycles accounted for 4.2% of all trips, which decreased to 1.9% in 2000 and further to 1.4% in 2010[6]. However, data from the 2021 census in North Macedonia indicate that in Skopje 4% of residents typically use bicycles for their travel, and possible explanations for this increasing were not given[5]. Having in mind the observed trends in cycling behavior, particularly within the context of Skopje, it becomes increasingly evident that there is a pressing need for further, more in-depth research to thoroughly understand the local cycling habits, identify the associated challenges, and develop targeted strategies to address these issues effectively.

The aim of this study was to investigate cycling behaviors, motivations, barriers, and route preferences among residents of Skopje, North Macedonia, with particular focus on factors influencing cycling frequency, travel patterns, and route choice in the urban environment.

Material and methods

An online survey including 1,169 people who were riding a bike for different purposes was conducted. The questionnaire consisted of 35 questions, administered via Google Docs. Of these, 23 were single-response multiple-choice questions, 8 were multiple-choice questions allowing multiple responses, and 4 required open-ended answers.

The questionnaire was designed to collect information on sociodemoFigure characteristics, cycling habits, safety behaviors while cycling, and perceptions of cycling infrastructure. It was distributed through multiple social media platforms, with particular emphasis on target groups such as cycling enthusiasts and individuals engaging in sports

through cycling. The survey was conducted across the territory of Skopje between May and November 2022. Participation was voluntary and anonymous, and no personally identifiable information was collected. Statistical analyses were performed using SPSS, version 16.0 (SPSS Inc., Chicago, IL, USA). Associations between nominal variables were assessed using Chi-square tests. Statistical significance was set at $p<0.05$.

Results

Detailed sociodemographic characteristics of the study population have been reported elsewhere[7]. Briefly, the study included 1,169 participants aged 20–64 years (mean age 37.8 years), of whom 52.7% were male and 46.8% female. Most participants had completed high school education (78.1%), while 21.4% had secondary education.

The majority of participants (over 70%) reported cycling between 7:00 AM and 6:00 PM, whereas 20% preferred cycling during evening hours. Regarding cycling frequency, 77.1% of participants cycled four to seven times per week, 19.1% cycled one to three times per week, and 3.8% cycled one to three times per month. Daily cycling was the most common practice irrespective of gender.

Seasonal variation in cycling activity was observed. The highest proportion of participants (95.6%) reported cycling during May and June, and more than 80% cycled between April and August. Lower participation rates were observed in December and February (24%), while October (76.8%), March (53.3%), and November (41.2%) represented intermediate levels of activity.

Regarding cycling distance, the most common category was 11-15 km (38%), followed by 1-5 km (34.5%) and 6-10 km (26.1%), whereas 1.7% of participants reported distances between 16 and 18 km. Examination of individual responses showed that 15 km was the most frequently reported single distance (23.3%), followed by 9 km (14.4%). The most common commuting duration was 11-20 minutes (33.1%), followed by 21-30 minutes (19.3%) and 31-60 minutes (19.3%). Regarding commuting distance, 47% of participants reported traveling 1-4 km, 38% traveled 5-9 km, and 14% traveled 10–30 km. The mean commuting distance was 5.6 km, while the mean cycling distance per trip was 8.9 km. The average commute duration was 31 minutes, whereas the average total cycling time per journey was 63.5 minutes (Table 1).

Table 1. Cycling distance, commuting distance, and commuting duration among participants

Variable	Category	n	%
Average cycling distance per trip	1-5 km	403	34.5
	6-10 km	305	26.1
	11-15 km	444	38
	16-18 km	20	1.7
Commuting distance	0.1 – 0.7 km	12	1
	1 – 4 km	549	47
	5 – 9 km	444	38
	10 – 30 km	164	14
Commuting duration	1-10 minutes	221	34.5
	11-20 minutes	387	26.1
	21-30 minutes	226	38
	31- 60 minutes	226	1.7
	61 - 180 minutes	110	23.3

The most common reasons for preferring cycling as a mode of transportation were the ability to reach destinations more quickly (79.3%) and perceived health benefits (78.9%). Other commonly cited reasons included enhanced well-being (71%), recreation (67%), economic

considerations (61.1%), preference for active rather than motorized transport (57.5%), and greater flexibility in completing errands (54.6%) (Table 2).

Table 2. Reasons for preferring bike transportation

Reason	Percent of participants (%)
I prefer active transport to motor transport	57.5
Not having parking places for cars	7.2
There is no public transport from my region or is irregular	38.2
Flexibility with running errands	54.6
I reach my destination faster	79.3
Health benefits	78.9
Economic / financial reasons	61.1
Comfort	27.5
It makes me feel good	71
Recreation	67
Health issues	41.4
Contribution to lowering noise levels	32.1

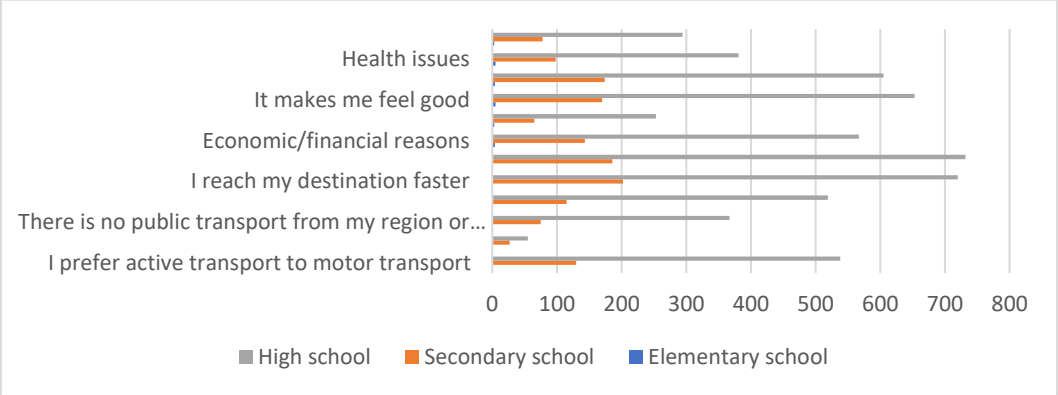

Fig. 1. Reasons for preferring bike transportation in accordance with education level Chi-square test, $p<0.001$

A significant association was observed between education level and reasons for preferring cycling ($\chi^2=74.884$; df=33; $p<0.001$) (Figure 1).
More than half of the participants (54%) identified the availability of dedicated bike lanes as the primary factor influencing route choice. Other reported factors included fewer physical obstacles (21.8%), shortest route (12%), availability of shade and rest areas (11.2%), and proximity to shops and services (1%) (Table 3).

Table 3. Key factor influencing route choice

Key factor	Percent of participants (%)
Particular bike lanes coverage	54
The shortest route	1
The least number of physical obstacles in the way	21.8
Most shadows and rest areas	11.2
Most shops, restaurants, local businesses, toilets and similar places of interest	1

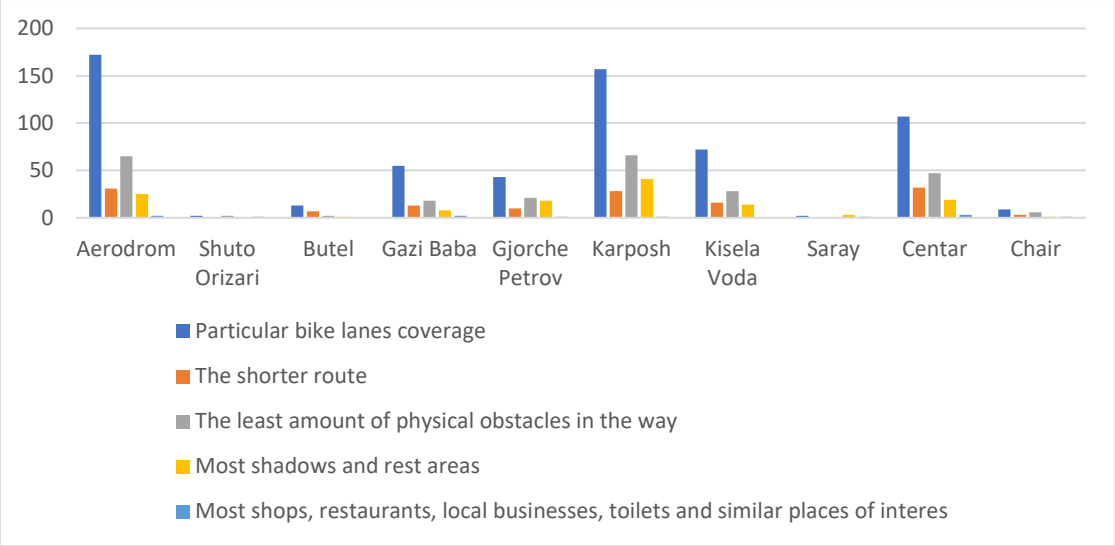

Fig. 2. Key factor influencing route choice for all municipalities
Chi-square test, $p<0.001$

Route choice factors differed significantly by place of residence ($\chi^2=81.943$; df=36; $p<0.001$; Cramer's V=0.132) (Figure 2).

Participants were allowed to select multiple responses. The most common reasons for riding a bike were recreation (76.1%) and commuting to work (70%), followed by shopping (35.3%), nature/off-road cycling (28.7%), and commuting to school/university (6.8%) (Table 4).

Table 4. Reasons for riding a bike

Reason	Percent of participants (%)
Going to school/university	6.8
Going to work	70
Shopping	35.3
Recreation	76.1
Nature, outside of the city, off-road	28.7

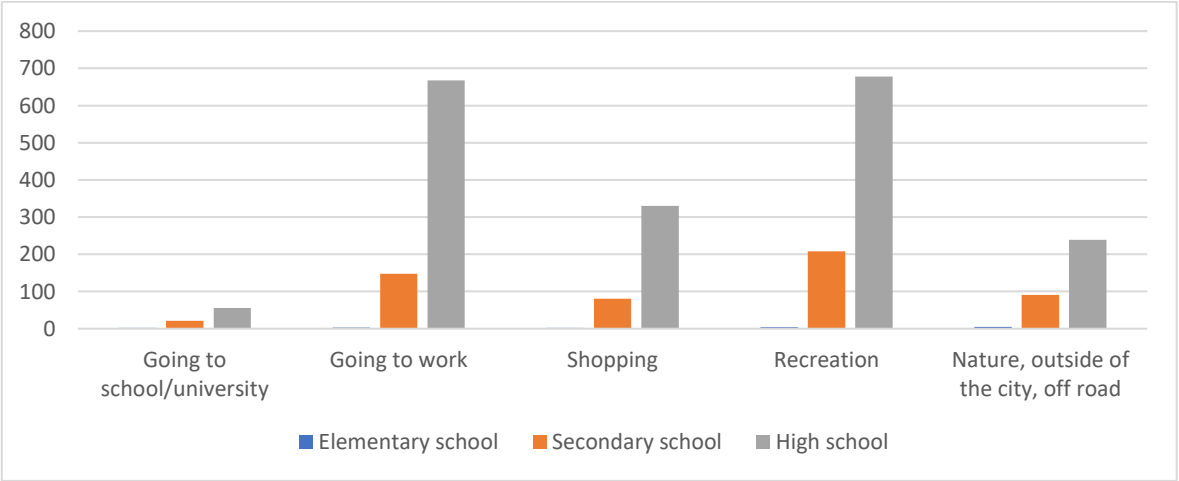

Fig. 3. Reasons for riding a bike according to the education level
Chi-square test, $p<0.001$

Reasons for cycling differed significantly by education level ($\chi^2=56.952$; df=10; $p<0.001$) (Figure 3).

Weather conditions were the most frequently reported barrier (79.4%), followed by insufficient bicycle infrastructure (42.7%), air pollution (36.3%), traffic safety (33.1%), and lack of safe bicycle parking (28.6%). Other reasons were reported less frequently (Table 5).

Table 5. Personal reasons for not riding a bike

Reason	Percent of participants (%)
Weather	79.4
Air pollution	36.3
Traffic safety	33.1
Not having enough bicycle pathways	42.7
My colleagues or people close to me do not use bikes; therefore I do not use it	1.4
Financial reasons	1
Do not have time in the morning	7.9
Not having parking lots for bikes	17.7
Not having safe parking lots for bikes	28.6
I think I am doing enough physical activity	0.8
Health reasons	3.8

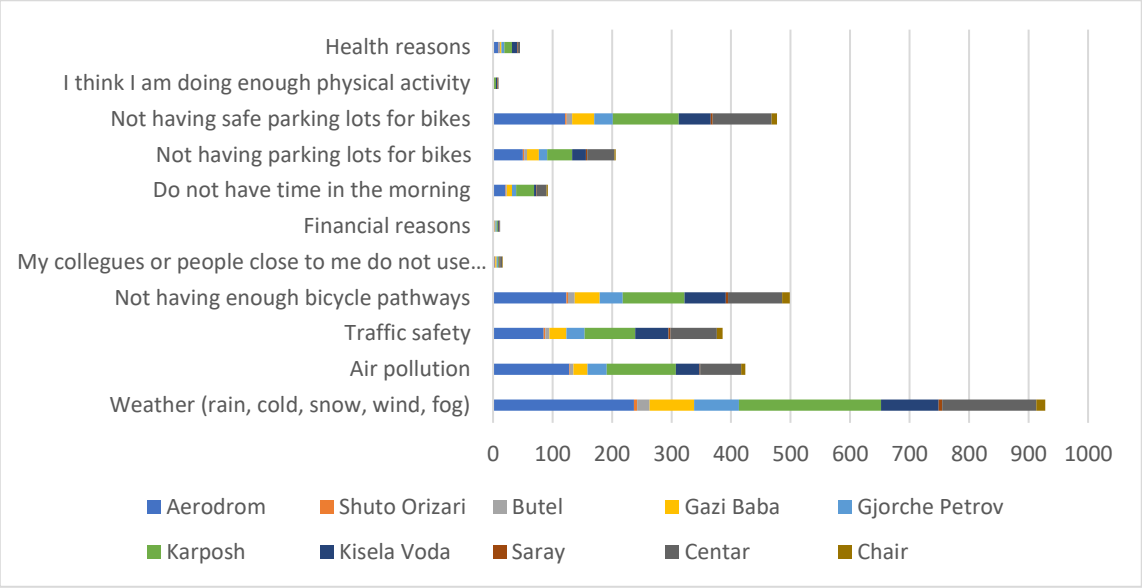

Fig. 4. Personal reasons for not riding a bike for all municipalities
Chi-square test, p<0.001

Reasons for not cycling differed significantly by place of residence (χ^2=198.418; df=99; p<0.001)[4] and by education level (χ^2=252.965; df=22; p<0.001) (Figure 5).

Regarding air pollution, 37% of participants reported cycling regardless of pollution levels, 25.3% reported not checking pollution levels prior to cycling, and 24.2% cycled when pollution levels were low. Smaller proportions reported cycling during mildly polluted conditions (11.5%) or refraining from cycling when pollution was high and officially discouraged (2%) (Table 6).

Education level was significantly associated with cycling behavior during air pollution (χ^2 = 30.644; df = 8; p < 0.001; Cramer's V = 0.102) (Figure 6).

The majority of participants (63%) reported that the COVID-19 pandemic did not affect their cycling habits, whereas 32.3% reported an increase in cycling frequency and 4.7% reported a decrease. Regarding financial support, 29.2% of respondents reported utilizing subsidies to purchase a bicycle, while 70.8% did not (Figure 7).

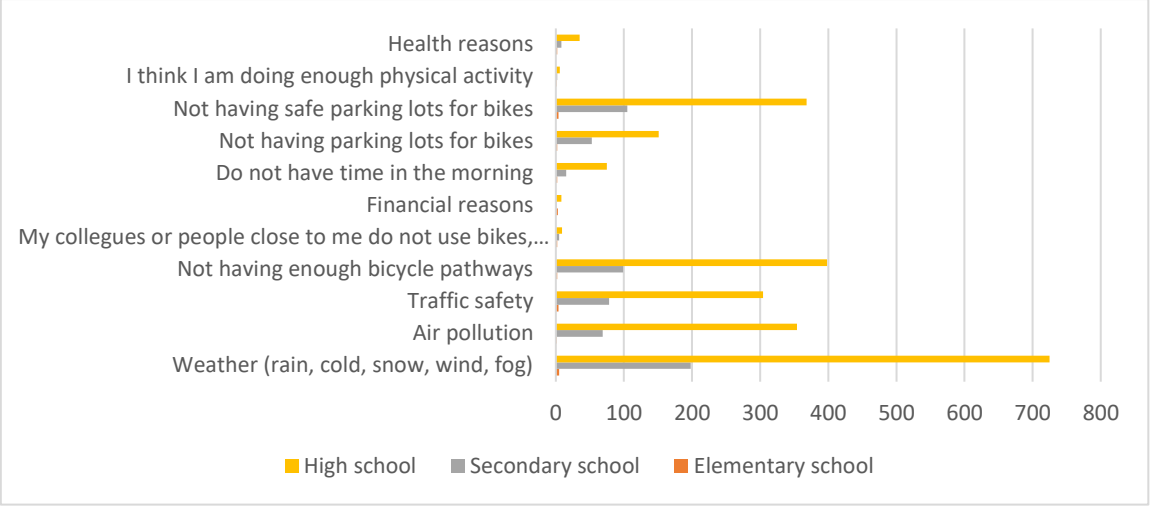

Fig. 5. Personal reasons for not riding a bike according to the education level
Chi-square test, $p<0.001$

Table 6. Bike riding habits and air pollution

Air pollution condition	Percent of participants (%)
Highly polluted air and government recommendations not to ride a bike	2
Mildly polluted air and no present recommendations to ride a bike	11.5
Low polluted air	24.2
Not related to the air pollution, I ride when I can and want to	37
I do not check and I do not get informed about air pollution prior to riding bike	25.3

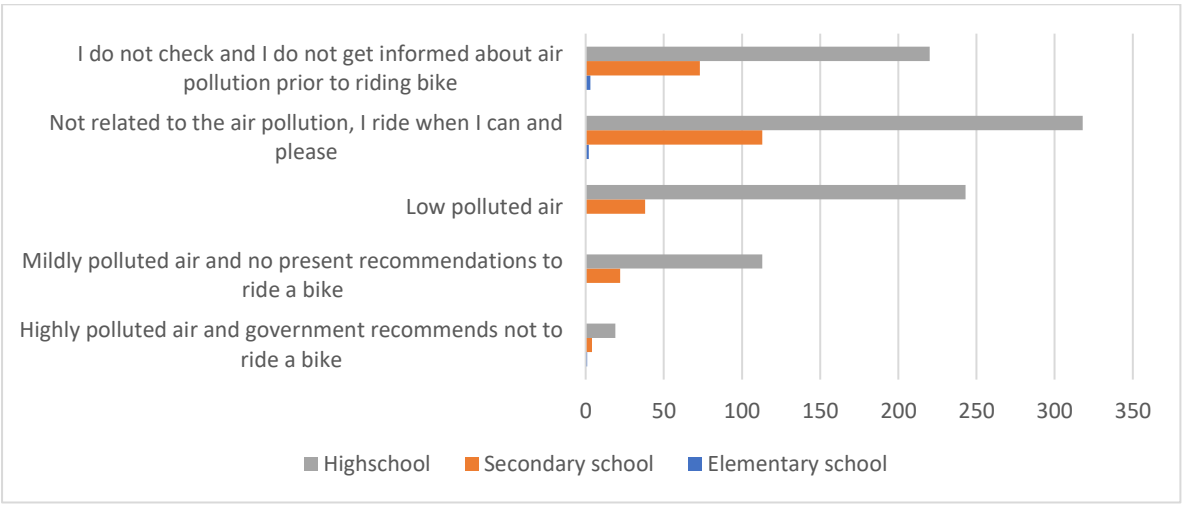

Fig. 6. Bike riding habits and education level
Chi-square test, $p<0.001$

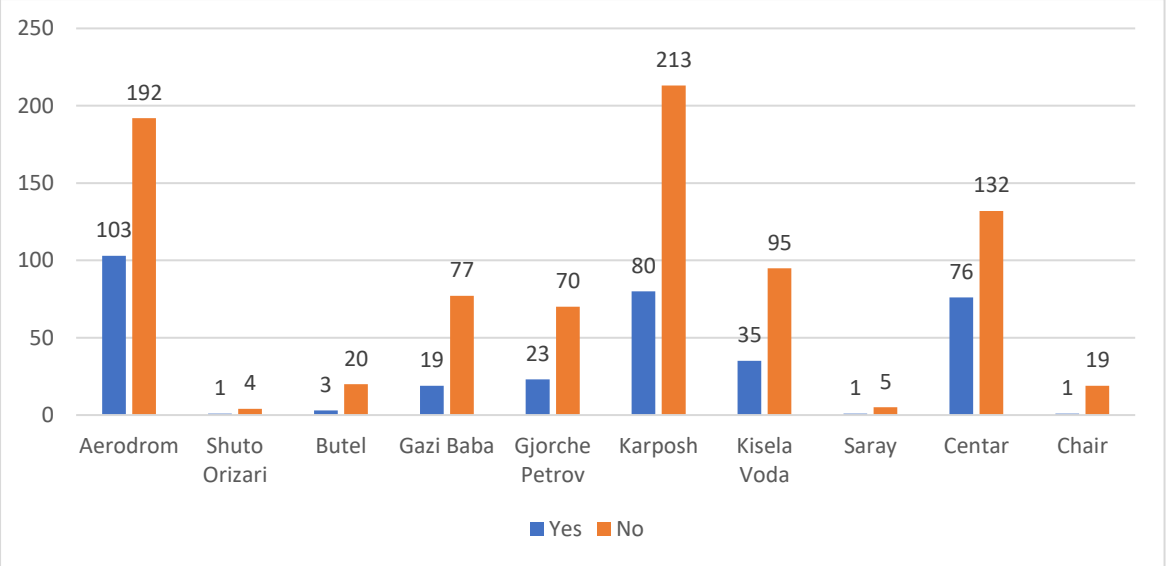

Fig. 7. Subsides usage to purchase a bicycle
Chi-square test, p = 0.003

Subsidy utilization varied across municipalities and was most frequently reported among respondents from Aerodrom, Karposh, and Centar, whereas the lowest utilization was observed in Kisela Voda. A significant association was observed between place of residence and subsidy utilization (χ^2=25.124; df=9; p=0.003; Cramer's V=0.147).

Discussion

Most participants reported cycling frequently, with the majority cycling four to seven times per week. Average trip distances were moderate, typically ranging between 1 and 15 km. Peak cycling activity occurred during the warmer months, particularly in May and June. When choosing routes, more than half of respondents identified the availability of dedicated bike lanes as the main influencing factor. Common motivations for cycling included reaching destinations quickly, perceived health benefits, and economic considerations, whereas the main barriers were adverse weather conditions, limited cycling infrastructure, and lack of safe bicycle parking.

Health-related motivations were strongly emphasized by participants, with most respondents identifying physical well-being as an important reason for cycling. This finding is consistent with previous evidence demonstrating that regular cycling contributes to cardiovascular fitness, mental health, and overall physical activity levels[8]. Recent studies further suggest that sustained cycling habits may prevent premature mortality and generate substantial economic benefits, emphasizing the broader societal value of promoting cycling in urban environments[9]. Although some studies have explored the optimal timing of exercise, our findings suggest that cycling occurs throughout the day without clearly defined temporal patterns, indicating that time of day may not substantially influence cycling behavior[10].

The frequent cycling observed in our sample corresponds with broader European trends, although considerable regional variation exists. In countries such as the Netherlands and the Nordic states, regular weekly cycling is common[11], while high cycling participation has also been documented in Germany and Austria[12,13]. Nevertheless, these findings should be interpreted cautiously. National data indicate that bicycle commuting in North Macedonia, including Skopje, remains relatively limited[14], suggesting that our sample likely represents a particularly active urban subgroup rather than the general population. Seasonal variation represents another shared characteristic. Declines in cycling during winter months and

increased participation during warmer periods have been consistently reported across Europe[15], a pattern similarly observed in the present study.

Trip characteristics also provide important contextual insight. In Northern European countries such as the Netherlands and Denmark, long-standing cycling traditions and supportive infrastructure contribute to regular daily use and somewhat longer average trip distances[16,17]. In most European Union countries, however, cycling trips remain relatively short, commonly ranging between 2 and 4 km, with durations typically reported between 12 and 20 minutes[14-21]. Differences in cycling duration and participation across regions have been associated with infrastructure quality, urban density, and cultural norms[22].

Cycling frequency further reflects these contextual differences. Regular weekly cycling is widespread in countries such as the Netherlands, Denmark, Finland, and Sweden, whereas overall participation across the European Union remains more moderate[23]. Although the high cycling frequency observed in our sample resembles patterns reported in high-cycling countries, this should not be interpreted as evidence of similarly favorable structural conditions in Skopje. Rather, it highlights the importance of infrastructure, urban design, and cycling culture in shaping participation levels.

Trip purposes varied considerably and were consistent with findings from other European settings. In Denmark, cycling commonly serves multiple functions, including leisure, commuting, errands, and education[17]. Similarly, Swedish studies identify exercise, flexibility, enjoyment, and environmental awareness as major motivations[24]. These multidimensional purposes correspond with our findings, where commuting and health-related motivations predominated, suggesting that cycling in Skopje similarly fulfills both practical and lifestyle-related roles.

Educational attainment emerged as an important determinant of cycling behavior. Previous studies have shown that individuals with higher educational attainment are more likely to cycle regularly and to associate cycling with health and environmental values, whereas lower educational groups more frequently perceive cycling as an economic necessity[25,26]. Comparable patterns have been reported in the Netherlands, Germany, and England, where cycling participation varies according to education level and urban context[26-28]. Our findings follow this tendency, as respondents with higher education reported more frequent cycling and stronger health-related motivations, reinforcing the role of socio-economic factors in shaping mobility choices.

The motivational drivers identified in our study are also consistent with broader evidence. A recent review recognized health benefits and physical fitness as primary motivations for cycling, followed by financial savings[29]. Similar patterns were observed among our participants, where health, speed, and economic considerations predominated over explicitly environmental concerns. This convergence suggests that practical and personal benefits remain central drivers of cycling uptake across different settings[30].

Despite strong motivational factors, several structural and environmental barriers remain evident. Air pollution represents a substantial concern in Skopje, which has repeatedly been ranked among the more polluted cities regionally and globally[31]. In our study, pollution was frequently identified as a deterrent, although a considerable proportion of participants reported continuing to cycle despite poor air quality, reflecting a degree of behavioral resilience similar to that described by Zhao *et al*.[32] Previous research indicates that responses to pollution exposure may vary according to age, income, and gender[30]. Limited use of real-time air quality information may additionally increase health risks[33], suggesting that improved public communication strategies could help mitigate this barrier.

Infrastructure remains a decisive factor influencing cycling participation. Participants emphasized the importance of physically separated bike lanes and secure parking facilities, consistent with findings from urban and university-based studies demonstrating a strong

relationship between infrastructure quality and cycling participation[30,34]. Recent evidence additionally indicates that many cyclists express dissatisfaction with existing cycling infrastructure and recommend expanding bike lane networks, strengthening enforcement of illegal parking, and reducing vehicle speeds at intersections to improve safety[9]. Beyond environmental and infrastructural barriers, cyclist behavior itself may also influence safety outcomes. Recent studies show that regular use of protective equipment is associated with lower accident risk, whereas mobile phone use or listening to headphones while cycling increases the likelihood of accidents[14]. The absence of continuous cycling networks and safe parking infrastructure in Skopje may therefore limit broader participation and discourage potential users.

Taken together, these findings indicate that although an active cycling subgroup exists in Skopje, broader participation depends on structural improvements, environmental conditions, and socio-economic context. Policies promoting safer infrastructure, reliable environmental information, and greater awareness of the health benefits of cycling may strengthen cycling as a sustainable urban mobility strategy. Future research should adopt a more integrated perspective that simultaneously considers infrastructure, environmental exposure, and social determinants in order to better support urban cycling development.

Several limitations should be considered when interpreting the findings of this study. First, the use of an online survey distributed primarily through social media platforms may have introduced selection bias. Individuals more engaged in cycling communities or more active on digital platforms were more likely to participate. Consequently, the sample may overrepresent motivated and frequent cyclists, limiting the generalizability of the findings to the broader population of Skopje residents. Second, the study relied on self-reported data, introducing the possibility of recall bias and social desirability bias. Participants may have overestimated cycling frequency, trip duration, or adherence to safety behaviors, while objective measurements of distance, duration, or environmental exposure were not employed. Third, the cross-sectional design restricts causal inference. Although associations between variables were explored using chi-square analyses, the study design does not permit conclusions regarding causality or directionality. Fourth, despite the relatively large sample size, the study was geographically limited to the territory of Skopje and conducted during a specific seasonal period (May–November 2022). Given the well-established seasonal variability in cycling behavior, the observed patterns may not fully reflect year-round cycling habits. Finally, although the questionnaire included several open-ended questions, reliance on a structured survey instrument may have limited deeper qualitative insight into the complex motivational and contextual factors influencing cycling behavior.

Conclusions

This study provides insight into cycling practices among an active subgroup of cyclists in Skopje, characterized by frequent cycling, moderate-to-long trip distances, and strong health- and convenience-related motivations. Cycling served both commuting and recreational purposes, highlighting its multifunctional role in urban mobility. Despite the high level of engagement observed in this sample, participants identified important barriers, particularly adverse weather conditions, air pollution, insufficient cycling infrastructure, and lack of secure bicycle parking.

The findings suggest that cycling in Skopje is currently sustained primarily by a motivated subgroup rather than being fully integrated as a dominant mode of urban transport. Strengthening cycling infrastructure, improving environmental conditions, and increasing institutional support may contribute to wider participation and more sustainable urban mobility patterns. Future policy efforts should prioritize safe and continuous cycling networks, reliable

environmental information, and greater public awareness of the health and practical benefits of cycling.

Conflict of interest statement. None declared.

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