

# Factors Affecting Elementary School Children's Preferences for Cycling to School; Case Study: Tehran City

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## ABSTRACT

Facilitating cycling for children is of strategic importance in the development of cycling culture. In the present research, the main research question is What are the factors enhancing elementary school males' preferences for cycling to school? It is necessary to simultaneously pay attention to items such as amending protective laws, social encouragement, and improving the quality of cycling infrastructure, in the form of a master plan. The present study aims to investigate how to develop cycling under indigenous conditions in Iran with an emphasis on elementary schools. By investigating factors affecting the use of bicycles, identifying the obstacles to it, and providing suggestions for improving relevant cultural and social conditions, enhancing the quality of cycle paths, creating bike parking, and so on, the present research attempts to find realistic solutions to improve the adults' attitude toward cycling to encourage their children to cycle to their schools as well as to places within the neighborhood. For this purpose, 14 variables related to children's preferences for cycling are identified through documentary studies and unstructured interviews. Next, using a structured questionnaire and asking 256 students from seven elementary schools, the variables were statistically measured, and then, classified into four personal, environmental, social, and functional factors through exploratory factor analysis. Results indicate that functional factors not only have the most impact on the development of cycling but are also effective in improving other indicators. Finally, a model is developed and explained for promoting children's preferences for cycling through explanatory-exploratory analysis.

**Keywords:** Children, Cycling Infrastructure, Cycling Culture, Path Separation, Elementary School.

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## 1. INTRODUCTION

Although, recently, in, Iran, some managers have verbally mentioned the importance of cycling, no necessary physical and cultural changes are still observed in the cities. In some larger cities, some efforts are made to invest more in the development of cycling and it is attempted to develop better infrastructure standards and improve the cultural environment. However, these efforts always face legal and political obstacles, in addition to financial limitations, causing bicycling ideas in different cities to be implemented with inadequate quality at improper speed.

Regarding cycling, among various age groups, the child age range is more important than other ranges since it is required to establish and promote the foundations of cycling culture among children to develop it in future generations. The advantages of children's cycling, including improving physical health and controlling children's obesity and inactivity, improving mental health and vitality, developing cycling culture, reducing traffic and air pollution, and so on, are often mentioned as policy goals, and they are less considered in executive processes, implying that people are very interested in developing cycling, but the lack of desirable conditions often inhibits and even suppresses this inner interest. Therefore, one can see the development of cycling in current conditions is often influenced by some internal factors, such as the child's internal interest, individual skills, parents' motivation and individual experiences, and the encouragement of their children, which are formed in different people in different ways.

The last decade has observed some efforts to promote cycling as a transport mode used within the city among adults, but no specific policy has been adopted to support children's cycling to school, which is considered one of the most important reasons for parents to worry about the safety of their children in the current traffic conditions in the cities. Inattention to this is a potential threat that can lead to a decrease in total cycling rates in the long term. In fact, the poor culture of children's cycling will lead to society's automobile dependency and consequences such as reduced social mobility and poor health of society in the long term. In Iran, the current conditions show increased public desire and parents' preferences for using automobiles to carry their children to school. According to the estimates of the present research, in the last two years, only about 1% of children cycled to school relatively consistently, which is very small compared to the same statistic in some developed countries, including the Netherlands (where 72% of elementary school children cycled to school consistently). Therefore, to investigate and identify the reasons for this issue, the present study attempted to identify the main and secondary factors and to provide desirable and feasible solutions to involved

people and groups.

The main research question is: What are the factors affecting elementary school children's preferences for cycling?

## 2. RESEARCH BACKGROUND

Numerous studies have been carried out on the cycling of children around the world. For example, one can mention Wang's studies in Australia in which it was concluded there is a significant relationship between children's cycling to school and their genders, the type of urban environment, the distance of the household to the school, the ownership of vehicles, and the parents and children's feelings of security. For example, they found that at distances of above three kilometers, the parents' preferences for cycling to school for the age range of children decreases (Karanikola et al. 2018). Opas, in a study on the youth of two indigenous groups in Amsterdam, also concluded that "to change the behavior of people of a non-cycling culture, it is not adequate to be exposed to bicycle-friendly infrastructure or a pleasant environment, and this issue definitely requires planning and cultural reforms related to the native context" (Ibsen and Olesen 2017). Most studies have referred to bicycle-motor vehicle accidents as a big obstacle for children and even adults to ride bicycles, indicating the improvement of this index in the design of bike infrastructure can be a solution to reduce the rate of accidents in the case of the cycling of children (Canitez 2019). Perceptually, segregating bike and motor vehicle paths increases children's and parents' preferences for cycling and minimizes their concerns about their safety on bike paths. Many relevant studies indicated that most cyclists prefer to move away from motor traffic and to cycle in environments with low traffic levels. Also, studies examining gender differences showed that women are more accepting of bike lane segregation than men (Beecham and Wood 2014). These studies also indicated that cycling reduces the sense of gender inequality among women.

Ducheyne, in studies on cycling training in schools, found that improving children's cycling skills is effective in choosing their routes, and children with higher cycling skills use shared cycling routes more confidently and with higher self-confidence to reach longer destinations. Therefore, it can be concluded that cycling training in schools will result in the development of sustainable cycling in cities and will increase the rate of cycling in cities in the long term (Karanikola et al. 2018).

Moreover, objective evidence and theoretical studies (Ibsen and Olesen 2017) emphasize that if schools have the necessary infrastructure, such as suitable supervised parking for bikes with shading or suitable solar canopies, and other desirable features, they will be greatly effective in students' acceptance of cycling culture. Regarding other centers, these facilities will

lead to adults' more accepting of cycling culture. Of course, there are many contradictions in this regard. It should be noted that according to this research, in some cases, not only the conditions for the presence of bicycles in schools are not provided, but also children are asked not to bring their bicycles to school through advertisements against the cycling culture, and in some cases, children are even prohibited from cycling to school to be forced to use school services (to help the school's economy). In such conditions, cycling to school will cause children to feel humiliated, definitely having an adverse and dangerous effect on the development of cycling culture in society in the long term. Therefore, it is always necessary to decide on the development of cycling infrastructure in society from an upstream perspective, considering political and cultural conditions. In a detailed study on this issue, it was stated that the low rate of cycling among women, as well as the significant decrease in the cycling rate after the age of thirty, may be due to the thoughts on cycling that are formed in childhood (Canitez 2019).

Many experts maintain that cycling provides a promising vision of creating a more sustainable transport system in today's cities that is both more accessible and affordable. Promoting cycling will make cities more efficient. Moreover, environmentalists and those groups promoting the slogan of sustainable development, under their slogan, raise cycling as a necessity to maintain the sustainability of the environment and protect the resources for today's children or the future generation (Ibsen and Olesen 2017). A study on 3847 7th to 9th-grade students in Denmark, "a country with a good cycling culture", found that children who went to school on foot or by riding a bicycle, have a lower body mass index and there is a lower probability of being overweight for them, compared to those who use other vehicles. In addition, in general, physically active children often outperform academically. This evidence implies that children's physical activity makes them more mentally healthy.

Kirsty Wild, in her studies, concluded that Cyclists are known as the happiest travelers. Changing the vehicle from a car or public transport to a bicycle causes a significant change in the direction of strengthening the well-being and mental health of children. Taking advantage of daily opportunities for peaceful and pleasant sports forms the main part of the pleasure of cycling. According to her research, the experience of sports of moderate intensity is considered the most enjoyable activity for most people. This type of physical activity motivates an individual to take stronger exercise and spend more time for exercise (Wild 2019). She believes that moderate exercise is useful for increasing mental alertness and improving mood and spirit.

Dundi et al. maintain that designing a bicycle network with an ability to meet the needs of all classes in society

requires an interdisciplinary team including experts such as traffic engineers, urban designers, ecologists, historical and cultural experts, transportation and urban planners, biologists, social scientists, landscape architects, geologists, and other experts if needed. The context analysis (site survey) examines the potential cultural, historical, economic, social, and environmental elements that may influence the project or be influenced by it. Information synthesis and interpretation of a statement of the context (determining needs) are among the tasks of such a group. This team can analyze the potential effects and provide the necessary information for the design to the group of experts (Ibsen and Olesen 2017).

Angela Hull studied the quality of cycling in European countries and found that three countries, the Netherlands, Denmark, and Germany, have adopted cycling as a tool to transform their cities into citizen-and child-friendly cities. These countries are more active than other countries in the field of safe, comfortable, and attractive cycling by prioritizing the movement of cyclists and the fulfillment of their needs, including extensive bicycle parking, integrating it with public transport, training cycling to a wide range of users, and promoting cycling (Wild 2019).

In general, it should always be noted that unidimensional solutions don't have the necessary efficiency for the development of cycling. Every action for developing cycling should be taken in the form of a master plan. Also, every action must be taken accurately and effectively. For example, the efforts made for the development of bicycle paths in Tehran in recent years have been not significantly effective in providing the required cycling infrastructure since they were scattered, discontinuous, and incoherent, and the necessary standards have not been observed in the location of paths and the design of path details. Reviewing previous studies indicate that there is a wide range of potential factors influencing the preferences of children and their parents for cycling to school, which are different based on contextual conditions. In fact, a good quality cycling environment can be a necessary but not sufficient condition. According to the research reviewed, economic factors, sociocultural development, family culture, personal interest, climatic conditions, some contextual conditions, and so on, are differently effective in improving cycling indicators.

### 3. METHOD

Since the rate of cycling among children in national examples in Iran is limited and often too low for analysis, the study of experiences is not adequately valid to investigate the current situation. Therefore, the present study more focuses on the collection of data from parents who themselves had the experience of riding a bicycle during their childhood, and now

they have a desire for their children to go to school by biking, but for the reasons that will be mentioned, their desire is often suppressed. The reasons, for example, are the uncertainty of the path safety due to non-standard paths, the drivers' dominance over the environment, or the low security of the route due to the occurrence of some social crimes or common verbal abuse, especially in neighborhoods where there are more social harms. The present study was carried out based on the statistics obtained from some schools in Districts 2 and 10 of Tehran Municipality, which, of course, are somewhat different depending on the contextual conditions in the district.

In the present study, first, the codes were extracted to identify the main criteria to investigate the factors affecting children's preferences for cycling to school by reviewing theoretical texts and authentic reports and asking for the opinions of relevant experts and some interested parents. The identified factors are as follows:

1. Lack of segregated standard routes;
2. The dominance of the drivers over shared routes and non-observance of the speed limit
3. Non-observance of the right of way of cyclists by drivers;
4. Lack of cycling culture and the presence of a sense of social humiliation;
5. Lack of facilitation and encouragement of children's cycling by the school;
6. Lack of feeling of social security while using a bicycle;
7. The far distance between school and home;
8. The high gradient of the path;
9. Lack of supervised and suitable bike parking;
10. Inappropriate weather conditions (air pollution, heat, cold, rain, etc.);
11. Low vitality of the route and lack of diverse uses;
12. The time-consuming nature of biking compared to the school transportation service;
13. Possibility of bike breakdown and lack of accessible places for quick repair;
14. Tiredness and sweating of the student after biking, which cause inappropriate conditions for attending class.

Then, to more accurately assess the abovementioned criteria in the intended conditions (two districts of Tehran Municipality), a research topic-related questionnaire was developed considering the native conditions of the subjects. The questionnaire includes 38 mixed questions on the 14 criteria

abovementioned as the factors influencing the students' and their parents' preferences for biking to school. The questionnaire is developed in such a way that it can be filled out within about ten minutes. However, in practice, in many cases, this process took longer and people entered into side discussions and discussed extensive qualitative content, which was also used in data analysis. Based on the nature of the present research, the best data analysis technique was exploratory.

The statistical population included the parents of elementary school males. No female students were included in the statistical population because there was no female student who rode a bicycle to school. The selected cycling areas were placed in Districts 2 and 10 of Tehran municipality, one of which had a prosperous social context and a relatively open physical structure, and the other with a non-prosperous social context and a compact physical structure. The studied students included 8% (i.e. 422 persons) of the total population of seven schools who showed interest in cycling to school at different levels, out of which 256 people participated in the present study and filled out the questionnaire acceptably. It should be noted that since the statistical population was limited, there was no need to use Cochran's formula to determine the sample size. Therefore, in this research, all involved and definable people were examined. In the process of completing the questionnaires, although theoretical saturation was also obtained after completing the first 150 questionnaires, a good correlation between the answers was seen, and no other new point was raised, the process was continued and 256 questionnaires were filled out. Out of the participants, 1% almost always used bicycles to commute to school (more than three days per week), 1.4% sometimes used bicycles to commute to school (less than two days per week), and 2.4% rarely used bicycles to commute to school (less than twice a month). Obviously, this study was carried out under the conditions of a lack of research cases, which partially reduced the accuracy of the research and made it difficult to prove actual behaviors. The developed questionnaires were distributed among the target groups in person or using social networks. Participants were told that the survey sought to "find out your attitudes towards children's cycling to school", and it was emphasized that the child's experience of cycling was necessary to complete the survey.

**Table 1. Statistical Analysis of Participants**

Studied Population	Number of People	Percent (about)
Total (7 Schools)	5272	100 %
Qualified People	422	8 %
Final Participants	256	4.8 %

Studied Population	Number of People	Percent (about)
Those who Rarely ride a Bicycle to Their Schools	129	2.4 %
Those who Sometimes ride a Bicycle to Their Schools	74	1.4 %
Those who Almost always ride a Bicycle to Their Schools	53	1 %

Finally, all the variables affecting children's preferences for cycling to school can be classified into four main factors. For this purpose, the codes extracted from the primary research were classified

into 4 main factors (i.e. P: Personal, E: Environmental, S: Social, and F: Functional) through exploratory factor analysis. Finally, they were prioritized based on their average scores.

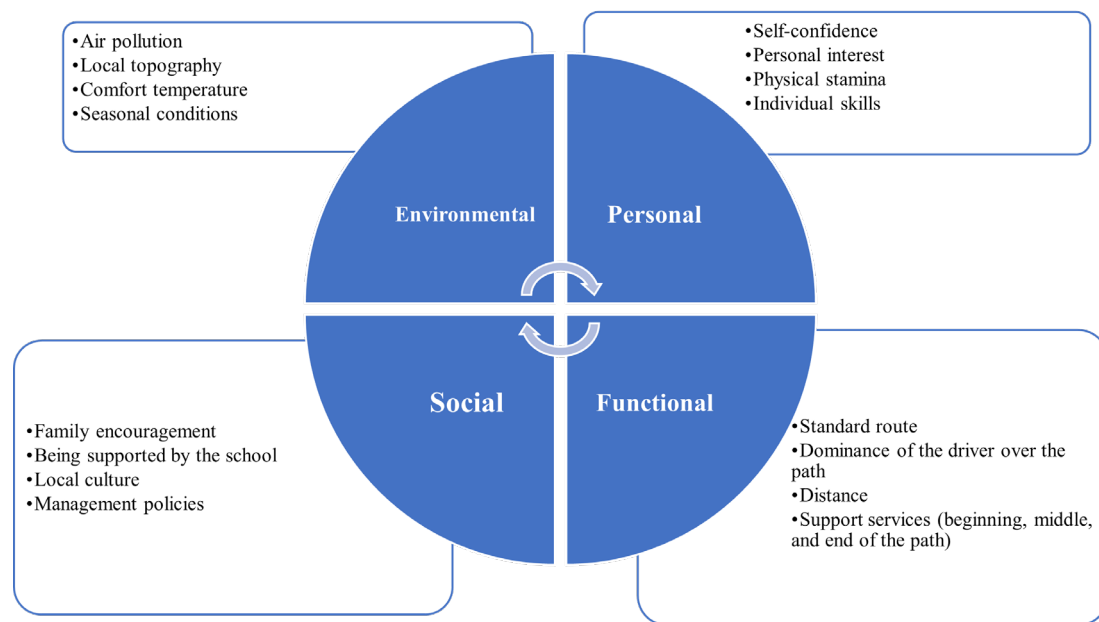


Fig. 1. Factors Affecting Children's Preferences for Cycling to School

#### 4. FINDINGS

In the process of interviews, different combinations of family members involved in the issue participated. Out of the 256 complete and acceptable interviews, 58.1% of the respondents were mothers, 32.5% were fathers, and 9.4% were children, all of whom were only in the 11-12 age group and younger children did not have the necessary sense of independence to participate in completing the questionnaire, but they helped their parents intellectually. Accordingly, it is better to say that in the results of this survey, the dominant point of view mostly includes the mothers' attitude toward children's cycling.

Another significant statistical point is that out of the total target population (i.e. children who ride bicycles), 72.4% of children aged 10 to 12 years (i.e. children who were studying in the second stage of elementary school), and 27.6% aged 7 to 9 years old (i.e. children who were studying in the first stage of elementary school, indicating that as the age group increases, children's self-confidence as well as their

physical ability to ride a bicycle increase significantly. According to some side points mentioned by the interviewees, it is believed that these factors made children of this age group feel more secure and ready to move around the neighborhood by bicycle, and riding a bicycle provides a kind of recreational attractiveness for them, in addition to being a tool for going to school (functional dimension).

Another remarkable point is that 62.3% of children were studying in the northern areas of District 2 and about 37.7% were studying in District 10 of Tehran Municipality, indicating that the level of well-being, social environment, quality of the physical environment, and so on influence children's cycling to school. Of course, as seen in the table below, one of the reasons for the desire of children in District 10 to ride a bicycle to school is the compact fabric of this district and the close home-school distances compared to other districts of Tehran, although this index is lower than that in District 2.



**Table 2. Comparison of the Statistics of the Participants**

Item	Amount	Percent
The Age of the Child	7-9	27.6
	10-12	72.4
Physical and Economic Status	Poor and Compact Fabric (District 10)	37.7
	Prosperous and Scattered Fabric (North of District 2)	62.3
Respondent Group	Mothers	58.1
	Fathers	32.5
	Children Studying in the 2 <sup>nd</sup> Stage of Elementary School (10-12 Years)	9.4
Cycling Frequency (Total) Subjects	Low	2.4 (50)
	Moderate	1.4 (29.1)
	High	1.0 (20.9)

The survey started in May 2019 and lasted about a month. It was performed by 3 experts in the field of cycling. In a series of preliminary meetings, the experts shared their ideas and opinions about cycling to agree on a procedure to interview the participants and obtain their opinions.

While receiving the results of the surveys, the interviewers also found some interesting marginal points. For example, in District 10, the condition of street paving was poorer, and many were concerned about potholes and the resulting safety problems. On the other hand, in this district, it seemed that children are more courageous in riding their bicycles, and according to both the parents and children, the

level of their risk-taking to face external dangers was higher compared to those in prosperous urban areas. However, the statistical indicators related to these areas showed that despite the greater desire of children to ride a bicycle, due to economic reasons and the limited budget of families to provide bicycles for children on the one hand, and the close distance of their homes to the schools and thereby, the accessibility of the schools on foot, the cycling rate in this district is not significantly different from that in District 2. Totally, the values in the table below were obtained based on a 5-point Likert scale (5: Agree very strongly and 1: Agree very slightly) in the questionnaire.

**Table 3. Comprehensive Prioritization of the Factors Influencing Children's Preferences for Cycling to School**

No.	Field	The 14 Factors Identified in order of Priority	Likert	Percent
1	F	The Dominance of the Drivers over Shared Routes (Urban Streets)	4.90	98.0
2	F	Lack of Segregated Standard Routes	4.79	95.8
3	S	Lack of Facilitation and Encouragement of Children's Cycling by the School	4.67	93.4
4	S	Non-observance of the Speed Limit and the Right of Way of Cyclists by Drivers	4.51	90.2
5	S	Lack of Cycling Culture and the Presence of a Sense of Social Humiliation	4.42	88.4
6	F	The Far Distance between School and Home	4.35	87.0
7	F	Lack of Supervised and Suitable Bike Parking	4.28	85.6
8	P	Lack of Feeling of Social Security while Using a Bicycle	4.01	80.2
9	E	Low Vitality of the Route and Lack of Diverse Uses	3.89	77.8
10	E	Inappropriate Weather Conditions (Air Pollution, Heat, Cold, Rain, etc.)	3.82	76.4
11	F	The Time-Consuming Nature of Biking Compared to the School Transportation Service	3.67	73.4
12	S	Possibility of Bike Breakdown and Lack of Accessible Places for Quick Repair	3.54	70.8
13	P	Tiredness and Sweating of the Student after Biking	3.36	67.2
14	E	The High Gradient of the Path	3.22	64.4

According to the results of the comprehensive survey (before the separation of different groups of participants), one can see that the factors affecting children's preferences for cycling to school were correctly selected and the lowest score is related to the "High gradient of the path" factor, which was reported as an important factor by above 64% of the respondents.

## 5. DISCUSSION

In specialized texts, ideas are always developed based on their specific contextual conditions and cannot be generalized to all contextual conditions. Even in a city, two schools may have different contextual conditions for children to cycle to school. School policies, topographical and physical conditions of the place in terms of access, social environment, and many other visible and latent variables create the realities in each research sample. In the present research, the authors try to find the real conditions of society as much as possible to reach more realistic results through an in-depth analysis extracted from structured questionnaires. Some cases such as banning using bicycles by the school, disgusting and humiliating behavior of some citizens, especially older children with younger child cyclists, especially in cases where they don't have adequate cycling skills, the high price of bicycles compared to household expenses (especially in the case of District 10), the inefficiency of bike sharing systems, the poor quality of bicycles in this system and some cases reported by parents are among other factors reducing parents' preferences for children's cycling, which could be investigated only through additional interviews along with the questionnaire survey. Since the present research includes questions on hypothetical situations or indeed "shoulds", it is inevitably limited and cannot predict the actual effect of factors. Thus, people's underlying preferences will be expected different in the case of children's participation. Since the basic table presents only the general results of the questionnaire survey, for deeper analysis, there is a need to develop more specialized tables to examine the results according

to the opinions of different participating groups. In these tables, as presented below, the results of the questionnaires are listed based on the economic and social status of the participants, the age group of the child, and the cycling frequency. Analyzing these tables helps to investigate the conditions and explain the differences. Moreover, it helps the authors to provide practical and useful suggestions for the development of cycling to school among children. Of course, it is possible to extract tables with more details. However, here, there may be no need for such tables, and the presented tables provide the required data for analyzing the situation well and achieving the necessary results.

### 5.1. The First Pairwise Comparison (Age Group)

The first table extracted from the basic table compares the opinions of the respondents of the first (7-9 age range) and second (10-12 age range) groups regarding the use of bicycles. The development of this table is important since the cycling rate among the first group was much lower than in the second group according to the primary statistics of the participants. Therefore, it is required to identify the challenges of children in this age range to provide appropriate solutions to promoting this mode of transportation among the children of this group to use it to access their schools. Increasing the cycling rate in this group can greatly influence the physical and mental health of the children of this group and be a basis for increasing the cycling rate in groups of older children because younger children's cycling to school acts as an incentive for older children, and this group will soon enter the second age group, while they already knowledge the cycling culture. It is noteworthy that in many cases, children ride a bicycle for recreational purposes around their homes, but they don't ride their bicycles to go to school. The reasons for this can be understood to a large extent from the results listed in the table below. It should be noted that considering the inclusion criterion of having an experience in cycling, 27% of the child participants were of the first age range, which is significantly lower than the statistic for the second age range.

**Table 4. The Opinions of Participants by the Child Age Group**

No.	The 14 Factors Identified in order of Priority	Group 1 (27.6%)	Group 2 (72.4%)	Difference
1	The Dominance of the Drivers over Shared Routes (Urban Streets)	98.4	97.2	1.2 %
2	Lack of Segregated Standard Routes	97.2	94.6	2.6 %
3	Lack of Facilitation and Encouragement of Children's Cycling by the School	92.2	93.8	-1.6 %
4	Non-Observance of the Speed Limit and the Right of Way of Cyclists by Drivers	92.2	89.2	3 %
5	Lack of Cycling Culture and the Presence of a Sense of Social Humiliation	81.4	90.8	-9.4 %
6	The Far Distance between School and Home	89.4	85.4	4 %

No.	The 14 Factors Identified in order of Priority	Group 1 (27.6%)	Group 2 (72.4%)	Difference
7	Lack of Supervised and Suitable Bike Parking	79.2	88.4	-9.2 %
8	Lack of Feeling of Social Security while Using a Bicycle	86.2	78.0	8.2 %
9	Low Vitality of the Route and Lack of Diverse Uses	87.2	70.4	16.8 %
10	Inappropriate weather Conditions (Air Pollution, Heat, Cold, Rain, etc.)	74.4	77.2	-2.8 %
11	The Time-Consuming Nature of Biking Compared to the School Transportation Service	71.2	74.2	-3%
12	Possibility of Bike Breakdown and Lack of Accessible Places for Quick Repair	91.2	65.8	25.4 %
13	Tiredness and Sweating of the Student after Biking	76.2	64.4	8.2 %
14	The High Gradient of the Path	84.2	57.2	29 %

In general, according to the above table and the comparison made, it is found that there are more unfavorable conditions for using bicycles by the children of the first age group. The most acute challenges, for which one can see a significant difference between the two age groups, are related to the following factors (in order of percentage difference):

1. The high gradient of the path (with a difference of 29%);
2. The possibility of bike breakdowns (with a difference of 25.4%);
3. Low vitality of the route and lack of diverse uses (with a difference of 16.8%);
4. Tiredness and sweating of the student after biking (with a difference of 8.2%); and,
5. lack of feeling of social security when using a bicycle (with a difference of 8.2%).

In these cases, the first age range seems to have more weaknesses than the second age range. In general, it seems that personal conditions such as poor physical strength relative to the surrounding physical and social environment have caused this group to feel more limited in using a bicycle. For example, in one case, a child lost his self-confidence and did not use his bicycle for a long time due to his bicycle breakdown on the path. Of course, in some cases, younger children had a preferential advantage over older ones. This difference is more obvious in the following two factors:

1. Lack of cycling culture and the presence of a sense of social humiliation (with a difference of -9.4%);
2. Lack of supervised and suitable bike parking (with a difference of -9.2%).

Although it is thought younger children seem to be more exposed and more vulnerable to social humiliation, this was not the case in reality because in many cases, they used to go to school with their parents or they were even encouraged due to their age. Children of this age group are experiencing the environment more and do not have a full understanding of what is happening around them, and for the same reason, their school friends are not yet involved in competitive emotions. Therefore, this group does not

have a special sense in this field, their personality has not yet matured adequately to understand the social environment, and they don't have a special sense of the nature of social interactions in the environment.

## 5.2. The Second Pairwise Comparison (well-being and Physical Quality)

Another pairwise comparison that helps us to analyze and understand the challenges of children's cycling to school is the comparison of participants' opinions on cycling in two prosperous and poor areas. Of course, it should be noted that these areas are not only different economically but there are also significant physical and social differences between them. The District 2 of Tehran Municipality, where most of the schools in the north part were selected as case studies, has a very scattered fabric and wide streets. In this district, children often have good-quality bicycles and often use their bicycles for recreational purposes, especially during summer vacations. While, District 10 of Tehran municipality, due to the poor economic conditions, has a fine-grained and compact fabric. Although the two districts are the same in total density, in District 2, density is shaped regularly and vertically while in District 10, it is formed horizontally with the small built-up areas of residential buildings and the fabric includes many irregular alleys and secondary alleys.

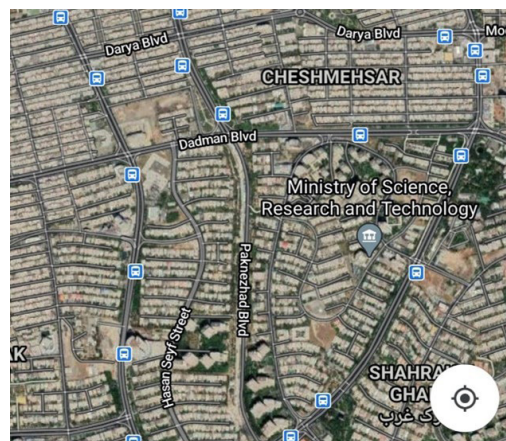


Fig. 2. Semi-Scattered Fabric of District 2



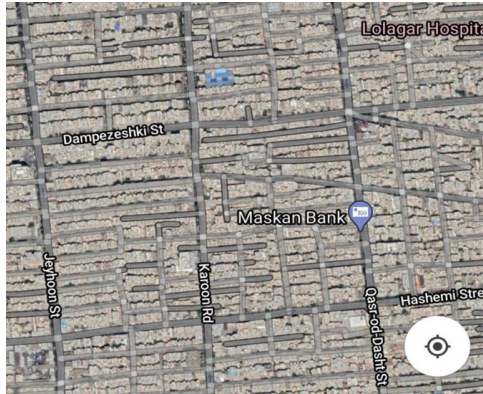


Fig. 3. Compact Fabric of District 10

For this factor, in District 2, a greater number of children use bicycles than in District 10. While the distance between the schools and houses is much closer in District 10, and apparently, children should not have any particular problem riding a bicycle to school. But, this has not been seen due to some reasons. According to the participants' opinions, among various reasons, the safety of the route, the physical weakness of the environment, and the lack of the school's encouragement of cycling are of great importance. Meanwhile, the schools in District 2, especially the two private ones, have shown more cooperation with children in the use of their bicycles.

Table 5. The Opinions of Participants by Prosperous and Poor Districts

No.	The 14 Factors Identified in order of Priority	Prosperous (62.3%)	Poor (37.7%)	Difference
1	The Dominance of the Drivers over Shared Routes (Urban Streets)	98.8	96.6	2.2
2	Lack of Segregated Standard Routes	93.8	98	-4.2
3	Lack of Facilitation and Encouragement of Children's Cycling by the School	88.2	98.0	-9.8
4	Non-Observance of the speed Limit and the Right of Way of Cyclists by Drivers	94.4	82.2	12.2
5	Lack of Cycling Culture and the Presence of a Sense of Social Humiliation	89.2	86.6	2.6
6	The Far Distance between School and Home	82.2	76.8	5.4
7	Lack of Supervised and Suitable Bike Parking	87.2	82.4	4.8
8	Lack of Feeling of Social Security while Using a Bicycle	78.2	85.4	-7.2
9	Low Vitality of the Route and Lack of Diverse Uses	83.6	66.2	17.4
10	Inappropriate Weather Conditions (Air Pollution, Heat, Cold, Rain, etc.)	74.0	81.2	-6.2
11	The Time-Consuming Nature of Biking Compared to the School Transportation Service	67.4	79.2	-11.8
12	Possibility of Bike Breakdown and Lack of Accessible Places for Quick Repair	67.6	77.2	-9.4
13	Tiredness and Sweating of the Student after Biking	74.4	51.2	-13.2
14	The High Gradient of the Path	69.8	54.6	-15.2

According to the participants' active participation rate in the survey and the opinions extracted quantitatively and qualitatively, the cycling rate among children living in District 2 was higher than in District 10. This can be seen through the analysis of the values in the above table. The following includes the factors in descending order of percentage difference. It should be noted that positive values in this table imply the superiority of District 2 over District 10 in the corresponding factors, and negative values show the superiority of District 10 over District 2.

- Low vitality of the route and lack of diverse uses (with a difference of 17.4%);

- The high gradient of the route (with a difference of 15.2%);

- Tiredness and sweating of the student after biking (with a difference of 13.2%);

- Non-observance of the speed limit and the right of way of cyclists by drivers (with a difference of 12.2%);

- The time-consuming nature of biking compared to the school transportation service (with a difference of 11.8%);

- Lack of facilitation and encouragement of children's cycling by the school (with a difference of 9.8%);

- Possibility of bike breakdowns and lack of accessible

places for quick repair (with a difference of 9.4%). Despite the physical weakness, the residents of District 10 seemed to be more satisfied with the factor "vitality of their environment". This factor plays a significant role in enhancing the security of the neighborhood, leading to the increased average preferences of children and parents for using bicycles. However, indices such as the higher level of air pollution in this region and also some other factors such as the lack of facilitation and encouragement of children's cycling by the school, have caused the lower preferences of children and parents for cycling in District 10 than in District 2.

District 2 has more topographical conditions and this issue caused a great reduction in the references of its residents for cycling compared to District 10. This issue, in addition to Factor 6 in the table above, i.e. the farther distance between school and home in District 2, had caused the students in this district to feel more tired when entering school, resulting in the higher score of District 2 in Factor 13.

In District 2, two factors have caused a relative increase in preferences for cycling in this district. First, the children in this district used better bicycles due to the better economic status of the family, and for this reason, their parents' concern about the possible bike breakdowns along the path was reduced to a great extent compared to District 10. On the other hand, since some schools in District 2 used the open education method, they provided more facilities to attract more students. This has caused these schools to be more accepting of children's cycling to school.

This has indirectly influenced the performance of other public schools in this district and has been accepted as an acquired right by other schools. In fact, this systemic support for the use of bicycles has increased the rate of cycling in this district.

### 5.3. The Third Pairwise Comparison (Frequency of Cycling)

Comparing opinions in terms of the cycling rate is also very important. This section investigated which factors people who use bicycles more than other people are more satisfied with. Examining, comparing, and analyzing these differences in detail, enable us to propose more appropriate frameworks for the development of cycling among children in the "Suggestions" section.

It is noteworthy that 8% of the total population of these schools used bicycles at different levels; 1% of students almost always ride a bicycle to their schools (more than three days per week), 1.4% sometimes used their bicycles to go to their school (less than two days per week), and 2.4% rarely used their bicycles to go to their school (less than twice a month). Obviously, this study was carried out under the conditions of a lack of research cases, which partially reduces the accuracy of the research. Although it will be a bit difficult to prove the actual behavior in such conditions, appropriate analyses and suggestions can be made based on this limited number of cases to improve the conditions.

**Table 6. The Opinions of Participants by the Frequency of Cycling**

No.	The 14 Factors Identified in order of Priority	Low (2.4%)	Moderate (1.4%)	High (1%)
1	The Dominance of the Drivers over Shared Routes (Urban Streets)	98.0	97.2	98.4
2	Lack of Segregated Standard Routes	95.2	94.2	97.4
3	Lack of Facilitation and Encouragement of Children's Cycling by the School	94.2	90.2	94.2
4	Non-Observance of the Speed Limit and the Right of Way of Cyclists by Drivers	92.4	88.2	90.4
5	Lack of Cycling Culture and the Presence of a Sense of Social Humiliation	88.2	86.4	90.2
6	The Far Distance between School and Home	87.4	87.0	86.0
7	Lack of Supervised and Suitable Bike Parking	84.8	87.6	85.4
8	Lack of Feeling of Social Security while Using a Bicycle	83.6	74.2	82.4
9	Low Vitality of the Route and Lack of Diverse Uses	77.2	77.8	79.2
10	Inappropriate Weather Conditions (Air Pollution, Heat, Cold, Rain, etc.)	76.2	74.4	77.4
11	The Time-Consuming of Biking Compared to the School Transportation Service	75.2	74.4	69.8
12	Possibility of Bike Breakdown and Lack of Accessible Places for Quick Repair	74.2	70.6	65.6
13	Tiredness and Sweating of the Student after Biking	71.4	69.2	58.4
14	The High Gradient of the Path	66.8	65.4	54.2

According to the above table, although there is no significant difference between the opinions of the three groups, it seems that the group with the highest frequency of cycling recorded the most dissatisfaction with the environment. At first, this issue seemed unlikely but the additional interviews provided interesting results. This group of cyclists was more familiar with the challenges of cycling in Tehran since they mostly used bicycles for commuting. But since their continued use of bicycles was related to individual aspects and not social and environmental aspects, this contradiction was logically justified.

In the friendly discussions with the families of this group to better understand their opinions, it was found that despite some dissatisfaction with the social and environmental conditions, reasons such as personal interest, family encouragement, self-confidence, doing more exercises during childhood, the location of the school, the distance between home and school, and so on have been more effective in their higher rate of cycling to school, indicating that the environment has not been able to play an effective role in encouraging child citizens to use bicycles. In fact, there is no successful systematic system to encourage citizens to use bicycles, and the people of the studied age range are fighting with the environment to use bicycles, and maybe, they will lose their motivation. For example, in an interview with the parents of a child in District 10, the reason for the child's use of a bicycle was the short distance between their home and his school, and they believed that if their home was further away from the school, they would probably use the bicycle less or use the school transportation service.

## 6. SUGGESTIONS

In general, considering the conditions abovementioned, one can conclude that in our society, the basic conditions for children's functional use of bicycles are not yet provided. Although children don't have any particular problem using the bicycle for recreational purposes in the neighborhood they face many problems if they want to use the bicycle to go to places out of their neighborhoods or to commute to school. This situation is so complicated that despite the interest of more than half of the children in the current situation, i.e. in a case where they are not encouraged to ride a bicycle or no emotional and cultural conditions are provided to use bicycles, only 8% of boys use their bicycles at various levels. Only 1% of them use bicycles continuously. The same value is close to zero for girls and does not allow researchers to study.

The same statistic is not at all acceptable in the current conditions of air pollution and traffic congestion in metropolises, and it is required to develop an accurate plan and make serious efforts to improve it. In addition to the functional benefits of reduced traffic

and decreased air pollution, cycling also has many benefits in social areas, for example, the attendance of children riding bicycles in urban spaces increases the mobility of urban spaces and enhances the vitality of cities. These conditions strengthen the sense of place from the human point of view and increase the sense of peace and security in space. Here, there is an important point: the opinions presented in specialized texts do not always correspond to the existing realities. The variety of contextual conditions has caused policies to be made in every urban environment based on its local coordinates, along with the observation of general principles.

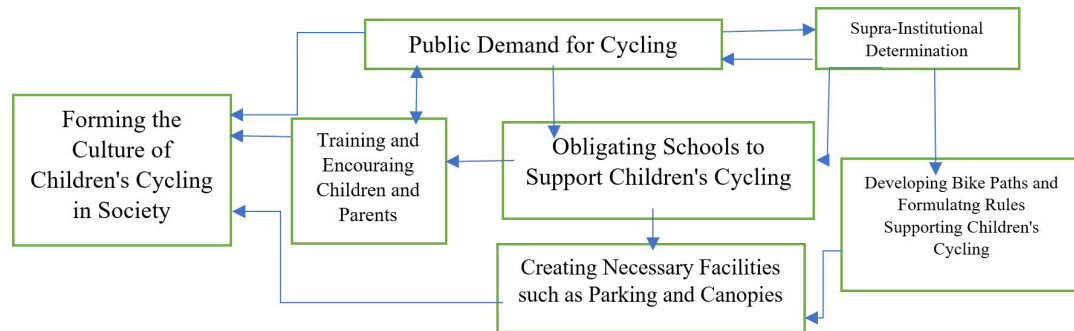
Therefore, to answer the main research question, in general, considering the conditions of Iran, and according to the results of free interviews and questionnaires, it should be acknowledged that the most important basic condition for the development of children's cycling is the will and determination of the urban management system to fulfill and facilitate the conditions, especially infrastructure development, and also the determination of the school management system to develop cultural conditions and encourage children to use this mode of transportation in the city. After achieving this requirement and general prerequisite, it is necessary to address the specific local criteria and neighborhood-specific conditions for the development of cycling. In specific circumstances, physical and social considerations must be considered for designing bike paths in each area, and there is no one-size-fits-all plan. Based on the investigations of the present study, it is not possible to develop bike-sharing paths in the compact fabric of District 10, and due to the high construction density and low width of the roads, the only way to develop cycling is to use shared paths. In such a situation, the use of signs and rules supporting the movement of cyclists against drivers can be a good solution to facilitate the attendance of cyclists in this district. While, in District 2, due to the greater width of the roads and the lower traffic flow, it is possible to consider a segregated standard bike path for cyclists.

Analyzing the output of the comparative tables shows that after the functional factors, some social factors such as the feeling of humiliation and verbal harassment, the lack of a suitable place to park the bicycle and the worry of bicycle theft, the lack of safety and security in the environment, are the most inhibiting factors for children's cycling. Of course, the degrees of these factors are different in different age ranges and should be considered in planning for the development of children's cycling. For example, for the age group of ten years and above, there are higher degrees of sense of pride, feeling of security, and self-confidence when riding a bicycle.

On the other hand, according to the results of the research, personal factors seem to play a much stronger role in increasing children's preferences for using bicycles than social and functional factors.

Variables such as the child's self-confidence, individual experience of cycling, cycling skills, familiarity with the route, the distance between school and home, family encouragement, and so on have played a significant role in increasing children's preferences for using a bicycle. Therefore, one can find that even in the presence of external systematic challenges, families can play an effective role in

raising children interested in cycling. Here, according to the recognition of the two studied districts of Tehran, as well as the analyses of the roles of various personal, social, environmental, and functional factors, the following model is proposed to explain the process of development of cycling in the urban environment of Tehran.



**Fig. 4. The Process of Development of Cycling in Tehran**

Forming a virtual family of cycling fans on social networks is another measure that can be suggested for the development of cycling among children. In the current situation, due to the lack of determination of urban management to develop cycling, the use of bicycles is considered a kind of struggle for the presence of this transportation mode in the spaces where motor vehicles dominate. Therefore, the acquaintance of these people with each other and forming civic groups of cycling fans can strengthen their motivation to continue this process. This synergy

of wills also allows them to use collective and shared capacities to request their demands from the decision-making authorities more firmly and with more effective follow-ups. Also, these groups can expand their activities by advertising, publishing educational videos, and attracting more interested people, and family support, some supporting specialized associations, as well as some interested officials, can play an effective role in improving the social position of cycling fans.



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