

Investigation of human-centered transportation (walking and biking) for low-income workers in Kabul, Afghanistan

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Abstract

Human-centered transportation (walking and biking) has been the cheapest, healthiest, and most convenient mode of transportation throughout history. In the new global economy, walking and biking have become common modes of transportation for low-income groups of people. Kabul is the biggest city in Afghanistan with scattered space organizations and currently is unfavorable for walking and biking due to insufficient attention to pedestrian and bicycle routes in city planning and poor road network and sidewalk conditions, which are among the issues that affect this 4-5 million population city. The purpose of this research is to analyze the current traffic situation in Kabul and identify the role and share of citizens' use of human-centered transportation (walking and biking) for transportation. This research also aims to investigate the relationship between the economic scope of low-income workers and the use of walking and biking for transportation. The statistical population of the current study was selected from three municipal districts as travel zones. Using cluster sampling, a sample participant of 929 people was obtained. It was observed that in the broad context, due to increasing cost and insufficient public transportation, low-income workers use bicycles and walking as a reliable mode of transportation. Finally, it is suggested that the spatial organization of Kabul is redefined and designed based on the new space organization, and the local organization and formulation of urban transportation strategies in urban strategic plans for pedestrian and bicycle transportation systems are strengthened, especially for roads leading to employment locations. Furthermore, in planning, priority is to be shifted to human-centered transportation (walking and biking).

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Keywords

Pedestrian life; human-centered transportation; walking and biking; Kabul; low-income workers

1. Introduction

Human-centered transportation (walking and biking) has been the cheapest, healthiest, and most convenient mode of transportation. Walking and cycling for daily transportation have more potential than leisure activities for physical activity. Focusing on transportation policies can also reduce air and noise pollution and improve health. Furthermore, increasing walking and cycling in the general population and among groups of interest reduces the cost of daily travel (Racioppi, 2002).

Research to date has tended to focus mainly on walkability as being beneficial for health and the environment as it helps reduce many health issues caused by obesity which is the result of an inactive lifestyle (Speck, 2018). Given the potential effects of economic stabilization and social equality that walkable neighbourhoods can provide, it is not surprising that recent studies have shown the resilience of these areas to economic crises (Gilderbloom et al, 2015).

Walking and biking are some of the most widely used modes of transportation for work purposes of low-income workers in the city of Kabul, Afghanistan, even though the roads and pedestrian route conditions are not favourable.

Human-centered transport (walking and biking) facilities are not provided in Kabul, and many roads lack sufficient width for safe passage by pedestrians. Consequently, on some roads, pedestrians are using the carriageways, causing conflicts with vehicles (JICA Study team, 2009). This situation reduces the traffic capacity and increases risks to nonmotorized transport as well. Furthermore, road crossing infrastructure including road marking for human-centered transportation (walking and biking) are insufficient. It is very dangerous for pedestrians and bikers to cross roads without such infrastructure, especially on roads with heavy traffic. Despite these problems, to improve walkability in the city, it is necessary to use effective measures and strategies to recover the lost identity of sidewalks and design complete streets.

1.1. Research question

-With all the above-mentioned uncertainties in city walkability in Kabul, why is the share of human-centered transportation (walking and biking) relatively high compared to other modes of transportation?

-To what extent do low-income workers benefit from the use of walking and biking for transportation?

1.2. Purpose

The purpose of this research is to analyze the current traffic situation in Kabul and identify the role and share of citizens' use of human-centered transportation (walking and biking) for transportation. This research also aims to investigate the relationship between the economic scope of low-income workers and the use of walking and biking for transportation.

2. Method

Simple statistical analysis was used to show the walkability share in Kabul. In this investigation, we used both qualitative and quantitative methods. We adjusted analyses for the person- and walkability factors associated with low-income workers.

3. Survy data and results

The data were collected from a one-day trip survey. Participants (n = 34140), mean age = 33.06 years) resided in 22 municipal districts across Kabul, Afghanistan. The statistical population of the current study was selected from three municipal districts as travel zones. Using cluster sampling, a sample participant of 929 people was obtained. The OD is summarized to that of three transport modes and five trip purposes (Figures 1 and 2). Three transport modes: i) walking, ii) public mode (= bus + taxi), and iii) private mode (car + truck). Five trip purposes: i) to go to work, ii) to school, iii) for business, iv) for private (shopping + others), and v) returning home. We used street interviews to subjectively collect data on Kabul transportation characteristics. We adjusted analyses for the person- and walkability factors associated with the low-income group of workers.

Table 1 Transportation modes share

Modes	Trips	Share	Modes	Trips	Share
Walking	1347918	28.87%	Taxi	467288	10.01%
Bike/Bicycle	282319	6.04%	PR Cars	709846	15.2%
Microbus	1411794	30.24%	SH Cars	179074	3.83%
Minibus	110693	2.37%	Truck	11828	0.25%
Bus	147074	3.15%	Total	4667834	100

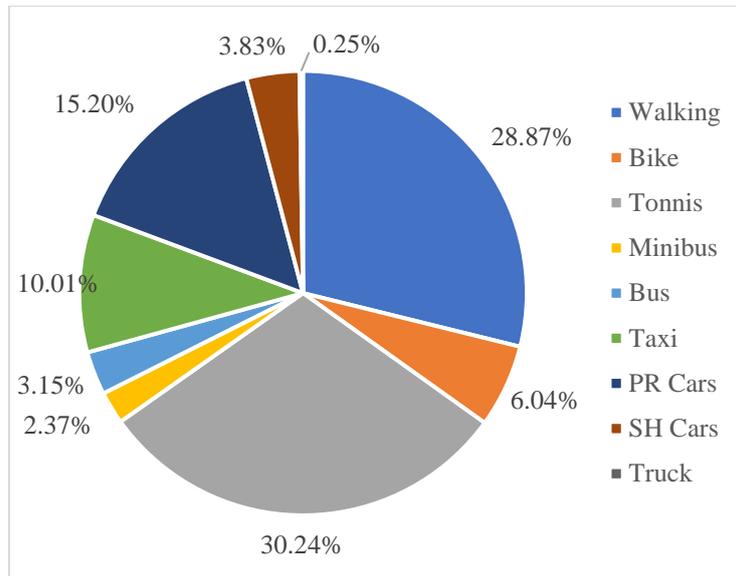


Figure 1 Transportation modes share

Table 2 Transportation share by purpose

Purpose	Trips	Share	Purpose	Trips	Share
Work	1675240	35.9%	Shopping	178042	3.81%
School	374243	8.01%	Home Re	2387447	51.14%
Business	52862	1.13%	Total	4667834	100

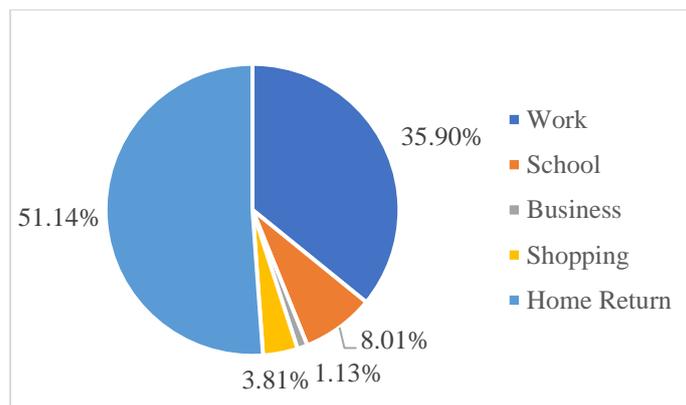


Figure 2 Transportation share by purpose

The total number of daily trips in Kabul in 2019 reached 4,667,834, including 1,347,918 on foot trips (by walking and bicycle from origin to destination) and 1,411,794 of those trips was done by micro buses which is counted as public transportation. In the 2008 calculation, non-motorized trips were higher than other modes of transportation, but in recent years, micro buses had more travel than trips on foot. Travel by other modes, such as bus, minibus, taxi, and private car, also has its share, which is shown in (Tables 3 and 4). Among the purpose of trips, most trips are made for work (35.9%), followed by school (8%), business (1.1%), and shopping (3.8%).

4. Study Area

Kabul is situated in the northeastern part of the country, at 1,800 meters above sea level. The city is located between 34°31'80" N and 69°10'29" E. It is the largest city in the country with approximately 1,023 KM² area, and the population is estimated at 4.4 million people (Statistical year book of Afghanistan, 2019-2020). The target area of this research consists of three districts out of 22 municipal districts of Kabul province.

In order to facilitate the survey and to effectively analyze the transportation system of Kabul, it was necessary to divide the city into main and sub-zones. The sub-zones are eliminated after the completion of the survey process, and no use is made in the analysis. The geological names of origins and destinations of the trip samples collected through the PT survey were converted into code numbers (coding) to facilitate the data assessment. The district centers were used for zoning within the city.

In most societies, sidewalks are the main component of the network of urban and local passages for rest, recreation, and walking of citizens. Unfortunately, in Kabul, sidewalks are considered paralyzed and forgotten places. In urban planning, priority has been given to motorized transportation. Evidence of this claim is the unfavorable physical conditions of streets and sidewalks even in the most important central parts of the capital city of Kabul. These problems are as follows:

- Existence of surface differences and physical barriers along the way
- Lack of proper urban equipment and furniture
- Lack of use of technically appropriate flooring materials on sidewalks and lack of necessary infrastructure
- Interference of adjacent business activities to the pedestrian way
- Occupation of large parts of sidewalks by shopkeepers
- Vehicles parking on the street
- Lack of proper bike lanes
- Lack of complete streets
- Other

5. Analysis

According to the one-day trip survey, the trips on foot have the largest share among the other trips within the district. The size of the district is large, and the trip distances between districts tend to be calculated much longer than the actual ones so that no clear relation between the trip distances and the share of trips on foot was observed. Therefore, a model formula for the modal share of trips on foot within the district by purpose is prepared to assume the maximum, as well as the sharing rate for a distance, not less than 10km, will become almost 0% (Figure 3).

$$P_{ij} = \frac{1}{1 + e^{(aD_{ij} + b)}} \quad (\text{Formula by JICA study team, 2018})$$

Where

P_{ij} Modal Share

D_{ij} Distance between i and j district (km)

a, b Parameter

Table 3 Parameters of modal choice model

Purpose	a	b
Work	0.5	0.5322
School	0.5	-1.45
Private	0.5	0.4055

Table 4 Mode choice share

Purpose	Walk Share
Work	37%
School	81%
Private	40%

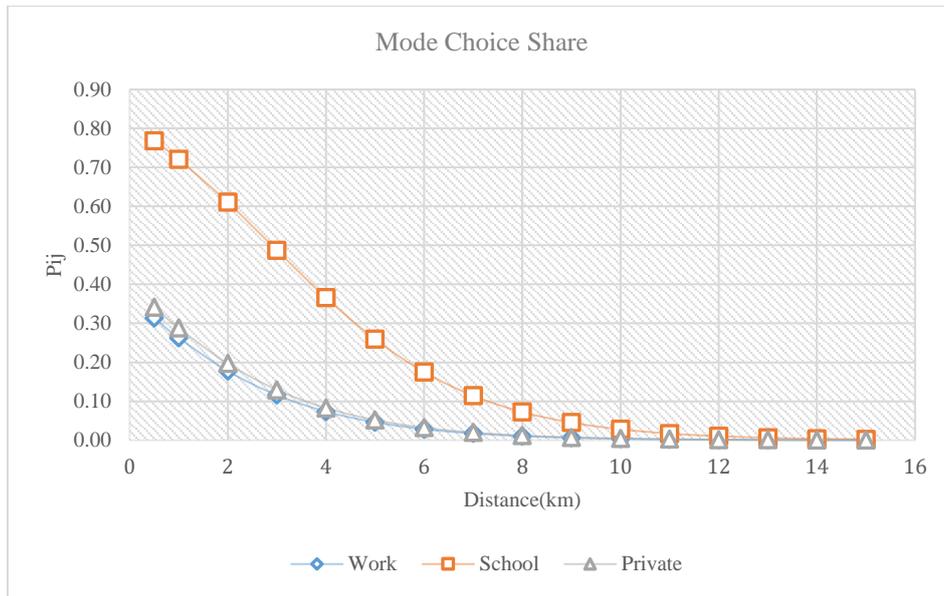


Figure 3 Modal sharing curve of trips on foot

According to (Figure 3), it is observed that distance of travel and modal share have an inverted relation.

6. Results

The first set of the analysis shows a significant share of the walking and biking modes of transportation, which consists of 37% altogether. The above share is for all the trip purposes, namely work, school, business, shopping, and home return. The result we are going to present in this research is the use of walking and bicycling for transportation for low-income workers. In order to accurately study citizen traveling patterns within the city, a question was asked from the statistical population to determine their daily travel cost, travel time, and travel distance. The results of which are as follows:

Table 5 One day travel outcomes for all purposes

Modes	Travel Cost					Travel Time					Travel Distance				
	Ct.	mean	SD	min	max	Ct.	mean	SD	min	max	Ct.	mean	SD	min	max
Walk	292	0.0	0.0	0	0	165	1.9	2.3	10	18	165	1.9	39.5	4	21
Bike	78	0.0	0.0	0	0	38	3.8	2.8	10	19	38	3.8	32.3	6	14
Microbus	221	31.3	16.8	10	100	126	6.9	4.8	19	30	109	6.9	66.3	4	6
Minibus	33	24.2	10.0	10	60	17	8.2	10.2	40	45	18	8.2	30.2	3	12
Bus	51	26.3	12.3	10	60	37	6.0	3.1	20	36	25	6.0	41.1	8	18
Taxi	86	79.0	41.1	20	220	53	7.5	4.7	20	35	60	7.5	50.4	10	22
Private	125	93.6	43.4	20	450	58	7.8	8.5	30	63	85	7.8	53.1	2	36
Share Car	43	44.4	15.2	20	80	19	5.5	3.4	30	47	29	5.5	31.6	16	24
	929					513					529				

(Table 5) is the result obtained from sample data of 1, 3, and 8 zonal districts that shows count, mean, min, max, and standard deviation of travel cost, travel time, and travel distance from sample participants (n=929). All of the participants declared their travel cost, while 513 declared their travel time and 445 declared travel distance. In the following linear regression, as stated by (Pradip Kumar Sarkar, Vinai Maitri and G.J Joshi, 2015), the relationship between the two variables is modeled by fitting the linear equation of the observed data, one variable as an explanatory variable or is considered an independent variable, and the other that is to be estimated is considered as a dependent variable. Intention is to find out the existence of a relationship between a dependent and independent variable. A simple tool for determining the relationship between two variables is to consider a scatter diagram (Figures 4 and 5).

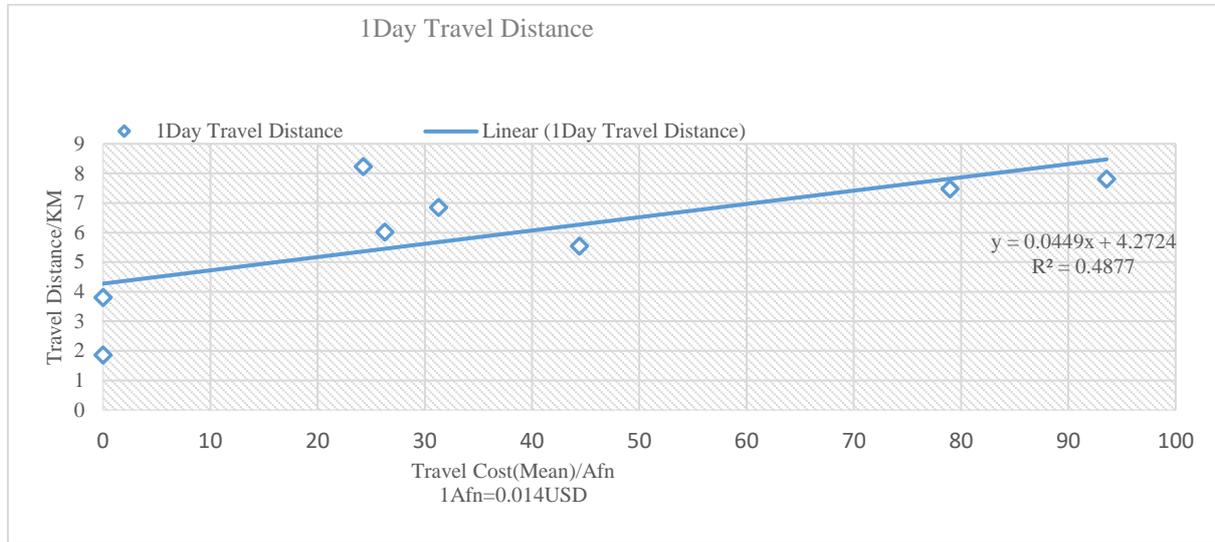


Figure 4 Modal sharing line of trips on foot in respect to distance

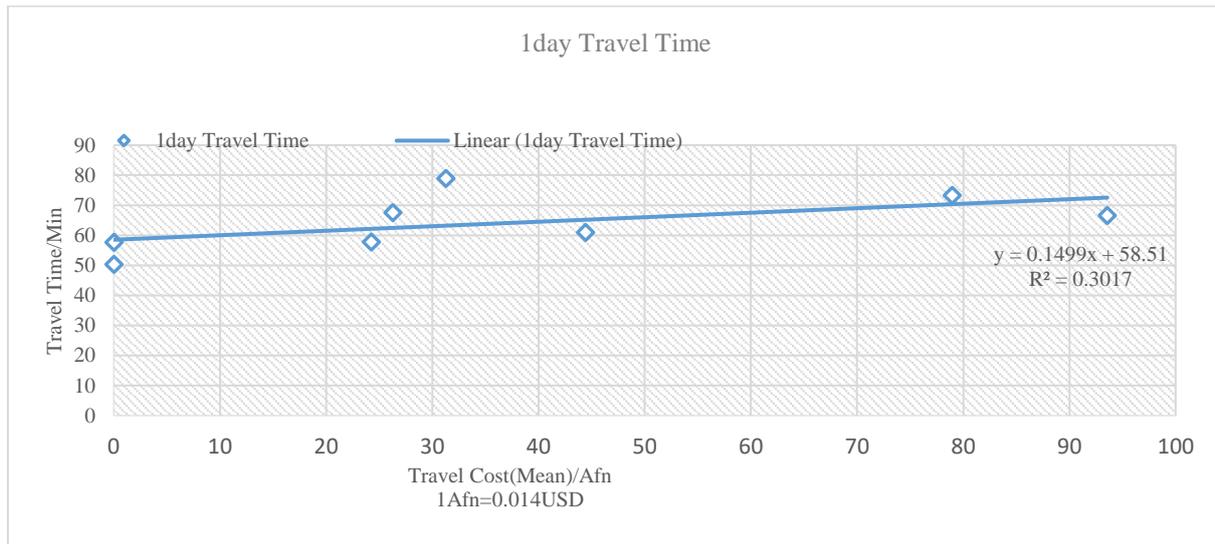


Figure 5 Modal sharing line of trips on foot in respect to time

The above diagrams show the direct relationship between the one-day travel cost of workers concerning their travel distance and one-day travel cost with travel time. The mean scores of one-day travel cost were compared with one-day travel time and one-day travel distance of all modes of transportation to present their correlations. The use of walking and biking modes of transportation are the highest for shorter distances. As the distances get longer, private cars are used to meet daily needs. Non-motorized modes of transportation (walking and biking) also confirm previous statements, with more usage in shorter travel times. In the final analysis of the relationship between the mode share for low-income workers and the high usage of human-centered transportation, according to (Figures 4 and 5), it was observed that in the broad context, due to increasing cost and insufficient public transportation, low-income workers use bicycles and walking as their reliable mode of transportation to a noticeable extent.

7. Share of transportation mode by trip distance

The trip distance discussed here means the shortest distance between gravity centers of districts measured along the trunk road networks. Therefore, it should be noted that the trip distance within the district is unclear, the distance measured along the trunk road may not be the shortest route, and the trip distances for the inhabitants living far from the gravity center may be longer than actual trip distances.

The share of trips on foot within the district, at 61%, is the highest. The average distance of trips on foot is 2.9 km (Figure 6 and Table 6).

Table 6 Transportation modes share in respect to trip distances

Distance	Trips (trips/day)				Share		
	Walk	Public transport	Private transport	Total	Walk	Public transport	Private transport
Intra District	1093300	533797	285685	1992408	55	27	14
0-2	21777	62724	56247	134493	16	47	42
2-4	7148	54313	30592	88284	8	62	35
4-6	42499	269558	89382	393703	11	68	23
6-8	63277	324066	126076	502441	13	64	25
8-10	53371	303420	109067	456388	12	66	24
10-12	15178	200909	73924	281212	5	71	26
12-14	13312	176204	64833	246631	5	71	26
14-16	25015	108650	43611	173801	14	63	25
16-18	14133	81548	27438	120857	12	67	23
18-20	1141	25167	6061	31704	4	79	19
20-22	6129	37746	14246	56776	11	66	25
22-24	5847	41279	20194	65001	9	64	31
24-26	5112	29064	10447	43717	12	66	24
26-28	5681	22283	7547	35087	16	64	22
28-30	2801	12553	4418	19462	14	64	23
30-32	3113	9210	3571	15731	20	59	23
32-34	254	213	139	613	41	35	23
34-36	163	1551	87	1817	9	85	5
36-38	0	0	0	0	0	0	0
38-40	1120	2710	973	4791	23	57	20
40-42	136	181	21	351	39	52	6
42-44	396	786	631	1760	22	45	36
44-46	217	432	154	806	27	54	19
46-	0	0	0	0	0	0	0
Total	1347918	2315923	1003993	4667834	29%	49%	22%
Avg. length	2.9 km	8.3 km	7.3 km	6.4 km	-	-	-



Figure 6 Share of transportation mode by trip distance

The number of people using public transportation tends to increase when the trip distance exceeds two km and shares not less than 60% in most of the ranges. The average trip distance of public transport users is 8.3 km.

The number of private transport mode users also tends to increase when the trip distance exceeds two km and shares around 20% in most of the ranges. The average trip distance by private transport is 7.3 km, which is shorter than that of public transport.

The shares of each transport mode are almost constant in most of the ranges except for the trips within the district. This is because most of the trips are concentrated in the center of Kabul regardless of trip distance (whether from districts close to or far from the center).

8. Modal split by purpose

The share of public transportation for commuting to work purposes is 60%, which is the highest, followed by private transport modes, such as passenger cars, motor bikes, etc. (Figure 7). Trips-on-foot shares 62% for the way to schools, followed by the trips with public transport sharing 29%. For business trips, the share of trips on foot was smaller compared to other purposes, and the share of private transport modes is higher instead. The share of public transport is high for the trips of private purpose, such as shopping, compared to other purposes.

Table 7 One day mode split by purpose

	Walk	Public transport	Private transport	Total
Work	234534	1005144	435562	1675240
	14.00%	60.00%	26.00%	-
School	232405	108156	33682	374243
	62.10%	28.90%	9.00%	-
Business	3859	32352	16652	52862
	7.30%	61.20%	31.50%	-
Private	23324	131573	23145	178042
	13.10%	73.90%	13.00%	-
Home	809345	1172236	405866	2387447
	33.90%	49.10%	17.00%	-
Total	1347918	2315923	1003993	4667834
	28.89%	49.6	21.51%	-

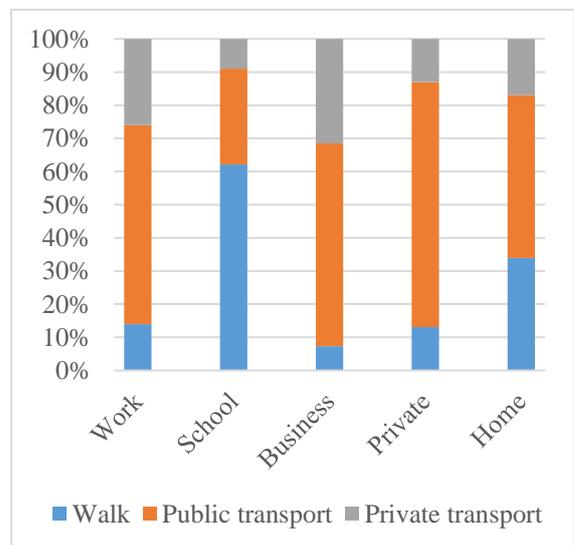


Figure 7 one day modal split by purpose of trip

9. Conclusion

The purpose of this study is to determine the limits of the use of walking and biking for transportation for low-income workers in Kabul Afghanistan. It was also shown that human-centered transportation (walking and biking) was mainly used for intra zonal (district) trips because of the lack of proper zonal connectivity and walking and biking facilities. Although the current study is based on a small sample of participants, the findings suggest the investigation can be broadened to cover all 22 zonal districts to obtain more precise findings. Finally, it is suggested that the spatial organization of Kabul is redefined and designed based on the new space organization, and the local organization and formulation of urban transportation strategies in urban strategic plans for pedestrian and bicycle transportation systems are strengthened, especially for roads leading to employment locations. Furthermore, in planning, priority is to be shifted to human-centered transportation (walking and biking).

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