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BICYCLE USE IN MIXED TRAFFIC IN URBAN TRANSPORTATION: THE CASE OF BALKH (AFGHANISTAN)

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Abstract: **The objective of this study is to assess the attitudes and behaviors of individuals using bicycles and motor vehicles in mixed traffic conditions. The study area selected for this research is the Balkh city, located in Afghanistan. A survey questionnaire was administered to a total of 500 participants. In this study, Confirmatory Factor Analysis (CFA) was employed for data analysis, utilizing data collected from the field. Additionally, the Structural Equation Model (SEM) method was utilized. Based on the prescribed sampling formula, a minimum sample size of 383 surveys is required for studies within a population of 250,000, with a 95% confidence level and a margin of error of 0.05. Consequently, the determined minimum sample size was established as 384. In an effort to mitigate sampling error and enhance the statistical robustness of the survey, the sample size was expanded to include 500 participants, comprising 250 cyclists and 250 car drivers, proportionate to the general population of the city.**

The statistical analysis confirmed the significance of all factors, and the assessment of model fit indices demonstrated that the obtained model exhibited a favorable fit.

Keywords: **Bicycle, Motor vehicle, Mixed traffic, CFA, (SEM), AMOS, Balkh, Maza-i-sharif.**

1. INTRODUCTION

Throughout history, transportation has consistently stood as a paramount determinant in fulfilling the essential requirements of human existence. The advent of industrialization, coupled with heightened production, has engendered urban sprawl and ushered in transformative shifts within the realm of transportation. The rapid urban transformations have precipitated the swift and inadvertent depletion of finite resources. In the context of sustainable transportation, discussions have revolved around land utilization, conjoined with economic considerations, environmental imperatives, and urban transportation systems. The utilization of pedestrian and cyclist modes of transport has reached a pivotal juncture concerning sustainability objectives. The overarching objective of sustainable transportation revolves around the amplification of pedestrian and cyclist utilization, concomitant with the curtailment of motorized vehicle reliance. Consequently, it is imperative to facilitate pedestrian and cyclist access, particularly in urban centers, with potential augmentation through synergistic integration with public transportation systems.

The bicycle, scientifically known as a velocipede, made its inaugural debut in the early 19th century and expeditiously progressed into a substantial mode of conveyance. It expeditiously garnered extensive acceptance for both utilitarian commuting and leisurely pursuits worldwide.

The first patent for a bicycle was granted to the French inventor Jean Theson in 1645. His invention was a four-wheeled device designed for two individuals to propel while seated. Subsequently, in 1690, the French noble Count Sivrac created a non-pedal bicycle known as the "Celerifere," featuring two wooden wheels. This innovation marked the inception of the concept of wheel rotation to drive the vehicle forward. This foundational idea, while initially limited in practical utility, laid the groundwork for significant advancements in bicycle development.

In 1817, Baron Karl von, a German innovator, introduced a two-wheeled vehicle equipped with a handlebar and saddle, which was affiliated with the Sivrac company. He christened this invention the "Draisienne" and publicly disclosed it in Paris (Aydilek and Sarıçiçek, 2017). The development of the bicycle gained momentum with the pivotal introduction of the pedal in 1839, credited to the Scottish inventor Kirkpatrick Macmillan.

The initial iteration of the modern bicycle is attributed to Ernest Michaud and his father, Pierre Michaud, who hailed from France. Many historians recognize them as among the first pioneers of the bicycle. They achieved a significant milestone by devising a bicycle closely resembling today's designs, achieved by siting the pedals on the front hub of the bicycle.

The objective of this study is to investigate the attitudes and behaviors exhibited by cyclists and motor vehicle drivers in the context of mixed urban traffic for urban transportation.

2. MATHERIAL & METHODS

Material

The material of this study is survey data. Questionnaire questions were determined to determine the attitudes and behaviors, qualifications and satisfaction rates of cyclists and motor vehicle drivers (Aydın 2006).

Determination of Survey Sample Size

Determining the sample size is very important for the accuracy of survey estimates. According to (Richardson et al. 1995), the more precision a survey requires, the greater the need for a sample survey. As the sample size increases, the sample variance decreases. Also, a good sample size should minimize the desired accuracy of the survey estimation.

Allowable standard errors are sampling error and coefficient of variation. According to the sampling formula, the sample size must be at least 383 surveys in studies with a population size of 250000, with a 95% confidence interval and a margin of error of 0.05.

The formula used in the sampling calculation is given below (Karasar, 2014).

$$n = \frac{Nt^2pq}{d^2(N - 1) + t^2pq}$$

Symbols used for the equation.

n: Sampling size.

N: Universe size.

t : At a certain level of significance. Theoretical value found according to the t table. t =1.96

p: The probability of the event under consideration occurring. P = 0.5

q: Probability of the event being examined not occurring.q = 0.5

d: It represents the margin of error. d = 0.05

The theoretical t value of the research corresponds to 1.96 with a 95% confidence interval and a sampling error of 0.05.

The minimum number of samples was determined as 384. In order to reduce the sampling error and gain the logical reliability of the survey, the sample size was 500 people, 250 cyclists and 250 car drivers according to the city's general population.

Methods

In this research study, Confirmatory Factor Analysis (CFA) was employed as the analytical methodology, utilizing IBM SPSS Statistics and SPSS AMOS Graphics software tools. Data collected from field observations were initially processed using Excel and subsequently imported into the SPSS program. CFA was subsequently utilized to ascertain the factor structures as a measure of construct validity. The analysis of the overall model and hypotheses was conducted employing a combination of IBM SPSS, SPSS AMOS Graphics, and IBM SPSS AMOS.IBM SPSS Statistics, an acronym for "Statistical Package for the Social Sciences," represents a widely adopted software application among researchers for conducting intricate statistical analyses. SPSS AMOS Graphics, an integral module within SPSS, is specifically designed to facilitate Structural Equation Modeling (SEM), path analysis, and confirmatory factor analysis.The formulation of hypotheses and identification of variables within the model were guided by pertinent literature sources, as referenced in Raykov and Marcoulides (2006). The Factor Analysis method was implemented to determine the optimal factor structure under which the collected data could be effectively categorized.

Factor analysis

Factor analysis serves the purpose of elucidating the intricate interrelationships among variables by effecting the transformation of a multitude of interdependent variables into a set of independent and significant factors. The principal objective of factor analysis lies in the revelation of the underlying structure inherent within a complex dataset, thereby aligning with widely accepted assumptions and facilitating comprehension of the fundamental associations among said variables. Particularly in disciplines such as social sciences, psychology, economics, marketing, and education, factor analysis finds frequent application in the examination of fundamental facets inherent to variables gauged through questionnaires or scales. Factor analysis encompasses two primary modes of application:

1-Exploratory Factor Analysis (EFA): This approach entails the determination of a factorial model, enabling the grouping of variables within a dataset based on a priori expectations or predictions. These hypotheses emanate from domain expertise, literature reviews, or theoretical frameworks. Unlike Confirmatory Factor Analysis (CFA), EFA is utilized to scrutinize and elucidate pre-defined factor structures.

2-Confirmatory Factor Analysis (CFA): CFA is a methodological process employed to construct latent variables (factors) based on observed variables, as per a pre-established model. It is commonly employed in the development of scales and the assessment of validity, or when the aim is to validate a predetermined structural model. The primary purpose of CFA is to empirically evaluate theoretical constructs.

In essence, CFA allows for the proposition of alternative models concerning the tested factor structure. To this end, a test model is established and compared against alternative models. In this study, survey inquiries pertaining to the attitudes and behaviors of cyclists and car drivers were employed to empirically elucidate the theoretical structure of Confirmatory Factor Analysis, as elucidated in (Nakıboğlu 2008)

Structural Equation Model (SEM)

Structural Equation Modeling (SEM) techniques find widespread utilization across various research domains, including satisfaction analysis. In the realm of transportation studies, numerous researchers have applied SEM to investigate passenger satisfaction in the context of public transport systems. The fundamental objective of structural equation analysis lies in demonstrating the validation of a specific relationship model based on empirical data. SEM is a prevalent choice in scientific research, primarily owing to its explicit incorporation of measurement errors associated with both dependent and independent variables within a given model.The rationale for adopting SEM in this study stems from several distinguishing characteristics that set it apart from classical multivariate statistical methods.

Firstly, SEM employs a confirmatory approach, contrasting with the exploratory approach commonly found in other statistical methodologies. While many statistical methods, aside from SEM, aim to uncover relationships within datasets, SEM seeks to affirm the congruence of theoretically posited relationships with empirical data. Consequently, SEM is deemed more efficacious in hypothesis testing compared to other approaches.

Secondly, traditional multivariate methods lack the capacity to estimate or rectify measurement errors. In contrast, SEM yields precise outcomes in error estimation. Traditional approaches typically address measurement errors independently, while SEM comprehensively elucidates measurement errors throughout all analyses.Thirdly, while traditional methods are confined to working solely with observable variables, SEM has the capability to conduct assessments encompassing both observable and unobservable variables within the same model.

Fourthly, unlike conventional regression analysis, structural equation models take into account measurement errors in variables. Consequently, regression analysis outcomes may produce erroneous and misleading results, as pointed out by Bayram (2013).

Lastly, in contemporary research, SEM stands unrivaled as a method that facilitates simultaneous testing of observed and unobserved variables, thereby enabling the measurement of numerous direct and indirect relationships. These distinctive attributes have catapulted SEM to its current status as a highly esteemed and widely embraced methodology in modern research (cite source, 2016).

3. RESULT & DISCUSSION

Results of Survey Studies

Following analysis, the demographic findings of the study reveal that 2.2% of the sampled population consists of females, while the remaining 97.8% comprises males. This gender distribution reflects the prevailing societal constraints in Afghanistan, where the majority of women face restrictions on bicycle usage. Consequently, the survey predominantly engaged male cyclists and car drivers. Among the participants surveyed, 25% indicated using bicycles for educational purposes, while a majority of 58% identified as undergraduates. The study primarily attracted participants from the student and civil servant demographics.

In the subsequent phases of the study, the analytical results are conveyed through the application of Confirmatory Factor Analysis (CFA) within the Structural Equation Modeling (SEM) framework, employing the AMOS software package.

Confirmatory Factor Analysis Results

Upon scrutinizing the normality statistics of the dataset, it is evident that the kurtosis and skewness values for the variables related to bicycle use, encouragement of bicycle use, motor vehicle use, and accident incidence conform to a normal distribution, as they fall within the generally accepted limits established by Tabachnick and Fidell (2013) of +1.5 to -1.5. However, it's worth noting that in human survey studies, attaining strict normality across multiple variables can be challenging, particularly in analyses involving a substantial sample size. Consequently, in studies characterized by a large sample size (n > 300), in accordance with the Central Limit Theorem, the assumption of normal distribution can be reasonably affirmed (Kalaycı, 2008). Subsequently, a first-tier Confirmatory Factor Analysis (CFA) was conducted, encompassing items associated with bicycle usage. The model output derived from the analysis results is depicted in (Figure1).

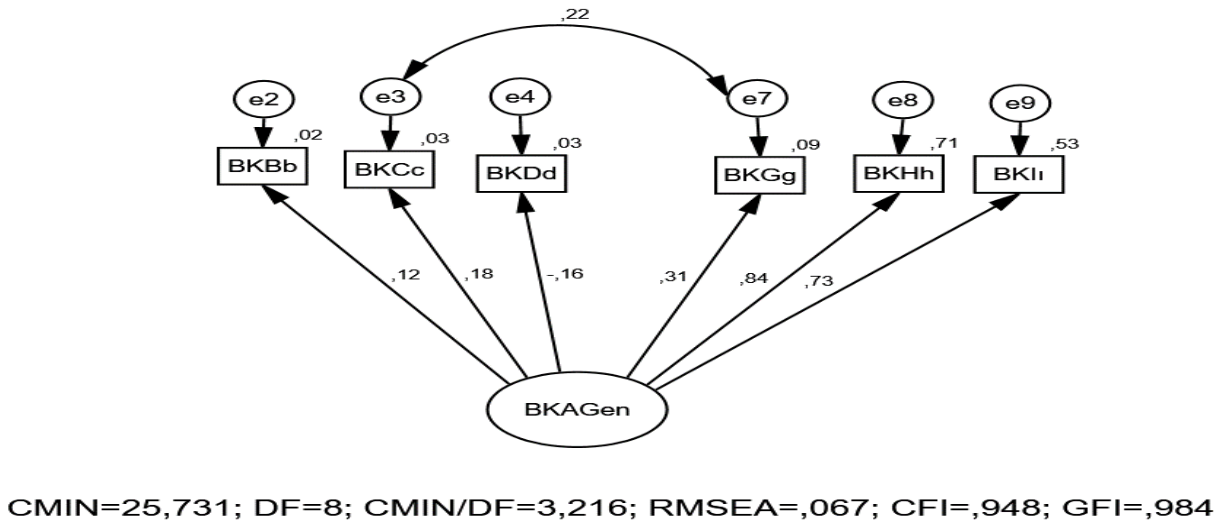


Figure 1: First-level CFA results of cycling in

The designated bicycle use factor comprises six observable variables denoted as BKBb, BKCc, BKDd, BKGg, BKHh, and BKlı. It is observed that the standardized regression weights for these variables range from 0.12 (BKBb) to 0.84 (BKHh), aligning with the anticipated theoretical structure. Notably, all these values exhibit statistical significance, with p-values below 0.05. The results from the initial level of Confirmatory Factor Analysis (CFA) meet the established criteria for model goodness of fit as per the literature, demonstrating acceptability (CMIN/DF = 3.216; RMSEA = 0.067; CFI = 0.948; GFI = 0.984). To attain the final model's satisfactory goodness of fit, adjustments were made to the error terms, commencing with the highest modification indices. The model achieved acceptability through the introduction of covariance between the error terms e3 and e7. The standardized and non-standardized regression coefficients, standard errors, critical scores, and significance values for the constructed model are presented in the accompanying table CFA results for Cycling in Table 1.

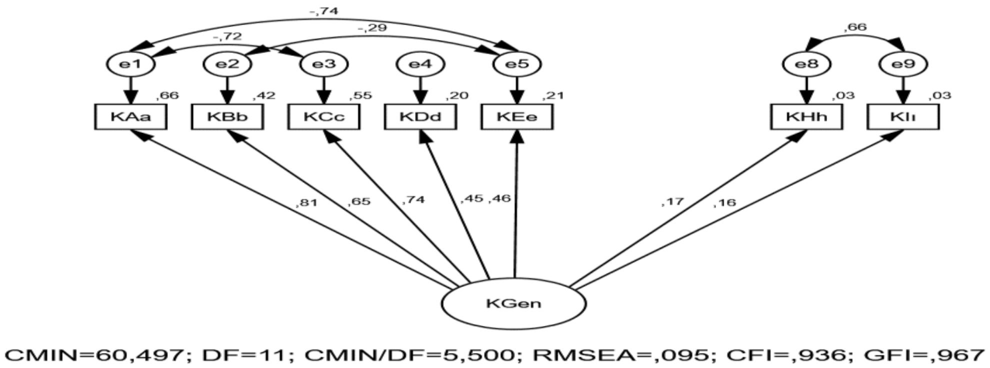
			β_1	β_0	SE	CR	P
BKBb	<---	BKAGen	0.159	0.123	0.066	2,429	0.015
BKCc	<---	BKAGen	0.336	0.177	0.097	3,455	***
BKDd	<---	BKAGen	-0.281	-0.164	0.087	-3.21	0.001
BKGg	<---	BKAGen	0.586	0.307	0.099	5,892	***
MDGh	<---	BKAGen	1,364	0.842	0.188	7,249	***
BKII	<---	BKAGen	one	0.726			

Table 1: β_0 = Standardized regression coefficient, β_1 = Unstandardized beta coefficient. ***= $p<0.001$.

Standardized regression coefficient and significant values of bicycle users.

For Bicycle Use confirmatory factor analysis results, goodness of model fit.

In Table 1, an examination of the road coefficients comprising six items associated with the bicycle use variable reveals their statistical significance. The coefficients are as follows: β0 = 0.123 for BKBb, β0 = 0.177 for BKCc, β0 = -0.164 for BKDd, β0 = 0.307 for BKGg, β0 = 0.842 for WHRh, and β0 = 0.726 for BKli. It's worth noting that the items BKAa and BCIe, included in the initial analysis, were omitted due to their adverse impact on model goodness of fit and convergence. Upon closer examination of the road coefficients, it becomes evident that the variable BKHh exerts the most substantial influence on cycling, with a coefficient value of β1 = 1.364. The Confirmatory Factor Analysis (CFA) outcomes pertaining to the research variables related to accidents are depicted in Figure 2.



CFA results for the accident in Figure 2.

The specified bicycle use factor comprises seven observed variables denoted as KAa, KBb, KCc, KDd, KEe, KHh, and Klı. It is evident that the standardized regression weights for these variables range from 0.16 (Klı) to 0.81 (KAa), aligning with the proposed theoretical structure. Importantly, all of these values exhibit statistical significance, with p-values below 0.05. The initial-level Confirmatory Factor Analysis (CFA) results demonstrate that the model fit indices generally align with the criteria specified in the literature, indicating acceptability (CMIN/DF = 5.500; RMSEA = 0.095; CFI = 0.936; GFI = 0.967). To enhance the final model's goodness of fit, adjustments were implemented among the error terms, commencing with those demonstrating the highest modification indices. The model's goodness of fit improved through the introduction of covariances between the error terms e1-e5, e1-e3, e8-e9, and e2-e5. The standardized and non-standardized regression coefficients, standard errors, critical scores, and significance values for the constructed model are presented in the accompanying table Accident-Related CFA results are in Table 2.

			β_1	β_0	SE	CR	P
KAa	<---	KGen	one	0.811			
KBb	<---	KGen	0.736	0.647	0.055	13,293	***
KCc	<---	KGen	0.889	0.744	0.063	14,053	***
KDd	<---	KGen	0.501	0.451	0.049	10,137	***
KEe	<---	KGen	0.501	0.459	0.061	8,154	***
KHh	<---	KGen	0.136	0.175	0.035	3,929	***
KII	<---	KGen	0.118	0.162	0.032	3,634	***

Table 2: β_0 = Standardized regression coefficient, β_1 = Unstandardized beta coefficient. ***= $p<0.001$.

Related to the accident confirmatory factor analysis results, goodness of model fit.

In Table 2, an examination of the road coefficients comprising six items associated with the accident variable reveals their statistical significance. The coefficients are as follows: β0 = 0.811 for KAa, β0 = 0.647 for KBb, β0 = 0.744 for KCc, β0 = 0.451 for KDd, β0 = 0.459 for KEe, β0 = 0.175 for KHh, and β0 = 0.162 for Kli. Notably, the items KFf and KGg, which were initially included in the analysis, were excluded due to their low factor loading, insignificant path coefficient, and detrimental impact on model fit.

Upon closer examination of the road coefficients, it becomes evident that the variable KAa exerts the most substantial impact on accidents, with a coefficient value of β1 = 1. The Confirmatory Factor Analysis (CFA) outcomes pertaining to motor vehicle use, one of the research variables, are depicted in Figure 3.

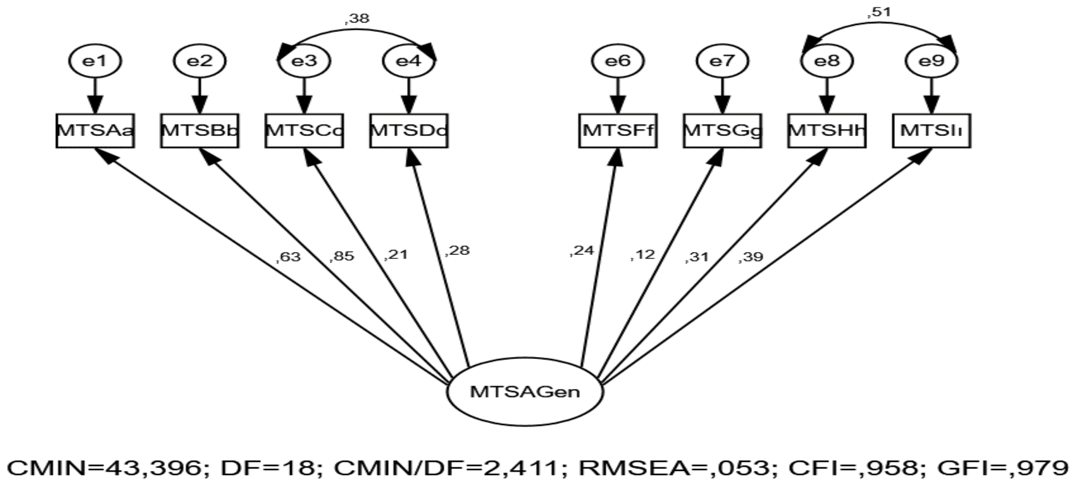


Figure 3: CFA Results for Use of Motor Vehicle.

The designated motor vehicle use factor comprises eight observed parameters denoted as MTSAa, MTSBb, MTSCc, MTSDd, MTSFf, MTSGg, MTSHh, and MTSII. It is evident that the standardized regression weights for these variables range from 0.12 (MTSGg) to 0.85 (MTSCc), aligning with the proposed theoretical framework. Importantly, all of these values exhibit statistical significance, with p-values below 0.05. The results from the initial-level Confirmatory Factor Analysis (CFA) indicate an excellent fit for the model goodness of fit indices (CMIN/DF = 2.411; RMSEA = 0.053; CFI = 0.958; GFI = 0.979). To achieve the final model's optimal goodness of fit, adjustments were implemented among the error terms, commencing with those demonstrating the highest modification indices. The model's goodness of fit was ultimately refined through the introduction of covariances between the error terms e8-e9 and e3-e4. The standardized and non-standardized regression coefficients, standard errors, critical scores, and significance values for the constructed model are provided in Table 3.

			$β_1$	$β_0$	SE	CR	P
MTSAa	<---	MTSAGen	one	0.631			
MTSBb	<---	MTSAGen	1,333	0.847	0.155	8,596	***
MTSCc	<---	MTSAGen	0.464	0.214	0.112	4,142	***
MTSDd	<---	MTSAGen	0.689	0.284	0.127	5,418	***
MTSFf	<---	MTSAGen	0.57	0.236	0.125	4,552	***
MTSGg	<---	MTSAGen	0.262	0.124	0.108	2,428	0.015
MTSHh	<---	MTSAGen	0.58	0.31	0.099	5,855	***
MTSIi	<---	MTSAGen	0.626	0.388	0.087	7,192	***

Table 3: $β_0$ = Standardized regression coefficient, $β_1$ = Unstandardized beta coefficient. ***= $p<0.001$.

Confirmatory factor analysis results of motor vehicle use model.

In the table, an examination of the path coefficients encompassing eight items associated with the motor vehicle variable reveals their statistical significance. The coefficients are as follows: β0 = 0.631 for MTSAa, β0 = 0.847 for MTSBb, β0 = 0.214 for MTSCc, β0 = 0.284 for MTSDd, β0 = 0.236 for MTSFf, β0 = 0.124 for MTSGg, β0 = 0.310 for MTSHh, and β0 = 0.388 for MTSIı. Notably, the item MTSEe, initially included in the analysis, was excluded due to its low factor loading, non-significant p-value, and adverse impact on the model's goodness of fit. Upon closer inspection of the path coefficients, it becomes evident that the variable MTSBb exerts the most significant impact on motor vehicle use, with a coefficient value of β1 = 1.333. The Confirmatory Factor Analysis (CFA) outcomes pertaining to government incentives for bicycle use, one of the research variables, are illustrated in the provided figure.

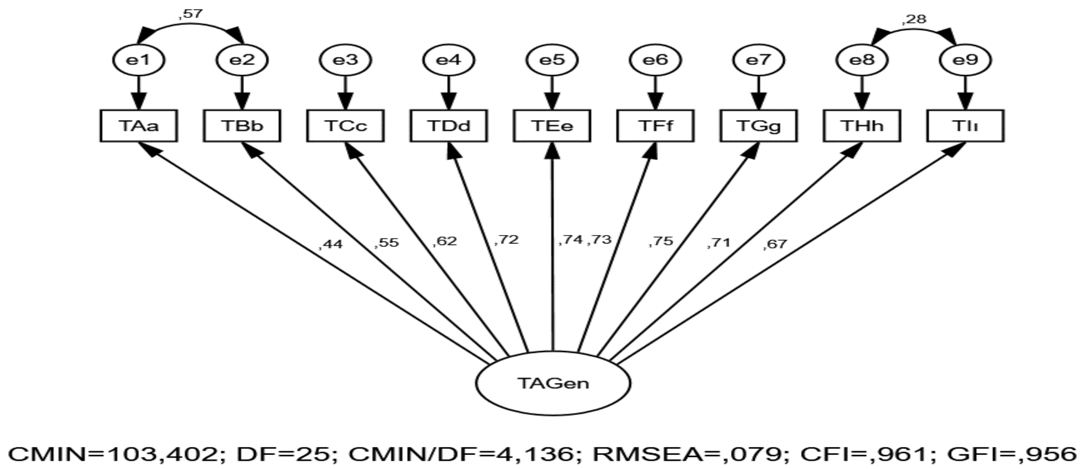


Figure 4: shows the CFA results for government incentives.

The government incentive factor related to cycling encompasses nine observed parameters denoted as TAa, TBb, TCc, TDd, TFf, TGg, THh, and TIı. It is noteworthy that the standardized regression weights for these variables range from 0.44 (TAa) to 0.75 (TGg), aligning with the envisaged theoretical structure. Importantly, all of these values exhibit statistical significance, with p-values below 0.05. The results from the initial-level Confirmatory Factor Analysis (CFA) indicate a favorable fit for the model goodness of fit indices (CMIN/DF = 4.136; RMSEA = 0.079; CFI = 0.961; GFI = 0.956). To achieve the final model's optimal goodness of fit, adjustments were introduced among the error terms, commencing with those demonstrating the highest modification indices. The model's goodness of fit was ultimately enhanced through the introduction of covariances between the error terms e1-e2 and e8-e9. The standardized and non-standardized regression coefficients, standard errors, critical scores, and significance values for the constructed model are detailed in Table 4 CFA results for State incentives for Cycling in Table 4.

			β_1	β_0	SE	CR	P
TAa	<---	TAGen	one	0.44			
TBb	<---	TAGen	1,195	0.548	0.099	12,136	***
TCc	<---	TAGen	1,592	0.621	0.184	8,669	***
TDd	<---	TAGen	2,805	0.719	0.305	9,195	***
TEe	<---	TAGen	2,015	0.739	0.217	9.29	***
TFf	<---	TAGen	1,942	0.733	0.21	9,259	***
TGg	<---	TAGen	1,758	0.754	0.188	9,351	***
THh	<---	TAGen	1,676	0.713	0.183	9,153	***
TII	<---	TAGen	1,564	0.675	0.175	8,954	***

Table 4: β_0 = Standardized regression coefficient, β_1 = Unstandardized beta coefficient. ***= $p<0.001$.

The Confirmatory Factor Analysis (CFA) results reveal the model's goodness of fit for government incentives targeting bicycle users.

As depicted in Table 5, the path coefficients pertaining to the nine items related to government incentives for bicycle use exhibit statistical significance. Specifically, the coefficients are as follows: β0 = 0.440 for TAa, β0 = 0.548 for TBb, β0 = 0.621 for TCc, β0 = 0.719 for TDd, β0 = 0.739 for TEe, β0 = 0.733 for TFf, β0 = 0.754 for TGg, β0 = 0.713 for THh, and β0 = 0.675 for TIı. No further inferences were drawn from the items included in the analysis. Upon scrutinizing the road coefficients, it becomes evident that the variable with the most substantial impact on motor vehicle use is TDd, with a coefficient value of β1 = 2.805. The results of the road model analysis, established to evaluate the research hypotheses, are depicted in the figure. The objective is to separately examine the constructed model for bicycle and motor vehicle users and assess the regulatory role of usage. Consequently, the model outcomes obtained from cyclist participation in Structural Equation Modeling (SEM) are presented in Figure 5.

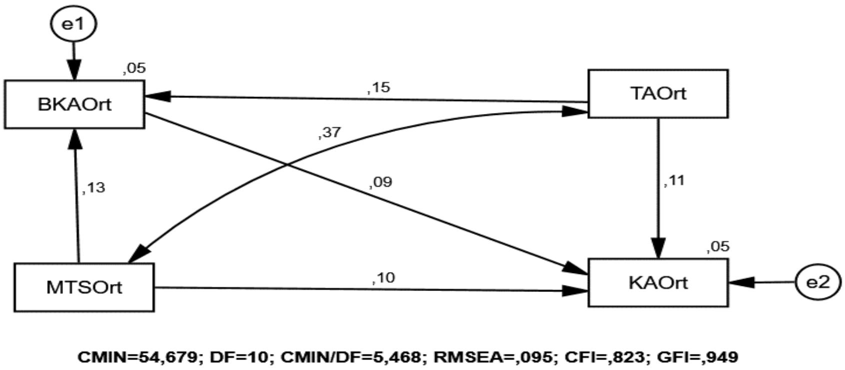


Figure 5: SEM Model Results of Cyclists.

Upon examining Figure 5, the outcomes of the path analysis fall within the specified limits in the literature with regard to the model's goodness of fit scores, demonstrating an acceptable level of fit (CMIN/DF = 5.468; RMSEA = 0.095; CFI = 0.823; GFI = 0.949). The results elucidating the causal relationships between the regression coefficients obtained in the analysis and the observed variables are presented in the accompanying table. This table provides details on both standardized and non-standardized regression coefficients, standard errors, critical scores, significance levels, and R-squared (R2) values of the model. Causal Results of the Model Obtained from Cyclists in Table 5.

			β0	β1	SE	CR	P	R2
BKAOrt	<---	TAAvg	0.116	0.148	0.015	7,508	***	0.055
BKAOrt	<---	MTSOrt	0.116	0.135	0.015	7,508	***	
KAOrt	<---	BKAOrt	0.116	0.089	0.015	7,508	***	
KAOrt	<---	MTSOrt	0.116	0.104	0.015	7,508	***	0.048
KAOrt	<---	TAAvg	0.116	0.114	0.015	7,508	***	

Table 5: β0: Non-standardized Regression Coefficient, β1: Standardized Regression Coefficient, ***: p<0.001

The SEM analysis results for the research model, derived from cyclists' data as presented in Table 5, indicate a notable and equivalently standardized impact of government incentives for cycling (0.148) and motor vehicle usage (0.135). In essence, this implies that 5.5% of the variability in cycling behavior can be accounted for by changes in government incentives for cycling and alterations in motor vehicle use. Furthermore, it is important to note that the variables pertaining to bicycle usage (0.089), motor vehicle use (0.104), and government incentives for bicycle use (0.114) demonstrate substantial and comparable effects on accident occurrences. Specifically, 4.8% of the variations in accident occurrences can be elucidated by changes in bicycle usage, motor vehicle use, and government incentives. These findings provide valuable insights into the interplay of factors influencing cycling behavior and accident rates among cyclists.

Compatibility indices of the YEM Model for Cyclists.

The outcomes of the Structural Equation Model (SEM) encompassing responses from motor vehicle users are depicted in the provided figure. This analysis scrutinizes the causal relationships among the relevant variables based on the responses provided by motor vehicle users.

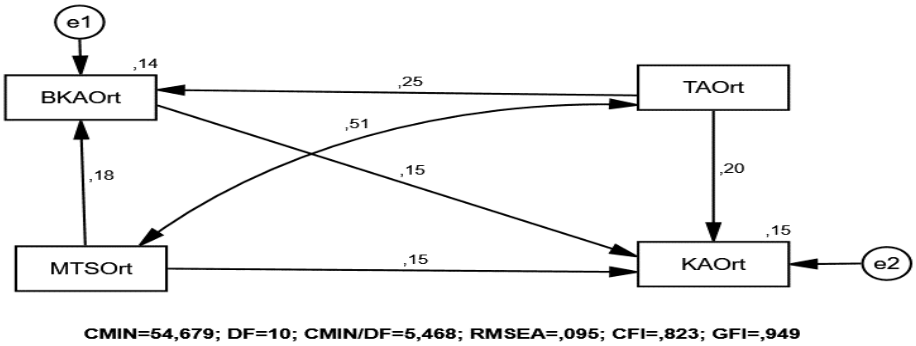


Figure 6: SEM Model Results of Motor Vehicle Users

Upon evaluation in Figure 7, the results of the path analysis closely approach the limits articulated in the literature concerning the model's goodness of fit indices (CMIN/DF = 5.468; RMSEA = 0.095; CFI = 0.823; GFI = 0.949). In the analysis, a covariance was introduced between the motor vehicle usage variable and the government incentives for bicycle use variable to enhance the goodness of fit scores. The causal relationship outcomes between the regression coefficients obtained in the analysis and the observed variables are outlined in Table 6. This table provides details on both standardized and non-standardized regression coefficients, standard errors, critical scores, significance levels, and R-squared (R2) values of the model.

Causal Results of the Model Obtained from Motor Vehicle Users in Table 6.

			β0	β1	SE	CR	P	R2
BKAOrt	<---	TAAvg	0.183	0.252	0.016	11,711	***	0.145
BKAOrt	<---	MTSOrt	0.183	0.183	0.016	11,711	***	
KAOrt	<---	BKAOrt	0.183	0.147	0.016	11,711	***	0.149
KAOrt	<---	MTSOrt	0.183	0.147	0.016	11,711	***	
KAOrt	<---	TAAvg	0.183	0.202	0.016	11,711	***	

Table 6: β0: Non-standardized Regression Coefficient, β1: Standardized Regression Coefficient ***: $p<0.001$

Upon examination of the responses provided by motor vehicle users as delineated in Table 6, a substantial and standardized impact of government incentives for bicycle use (0.252) and motor vehicle usage (0.183) on bicycle utilization is discerned. To put it differently, 14.5% of the variability in bicycle usage can be accounted for by alterations in government incentives for bicycle use and changes in motor vehicle usage. Furthermore, it is noteworthy that the variables associated with bicycle utilization (0.147), motor vehicle usage (0.147), and government incentives for bicycle use (0.202) exhibit significant and analogous effects on accident occurrences. Specifically, 14.9% of the variations in accident incidents can be elucidated by variations in bicycle utilization, motor vehicle usage, and government incentives. These findings shed light on the influential factors affecting bicycle usage patterns and accident rates among motor vehicle users

Compatibility index of the YEM Model for Motor Vehicle Users.

During the regulatory analysis conducted with the AMOS software package, the examination of parameter comparisons aimed to assess the significance of changes in the path coefficients of the created SEM models. The intersections with Z scores exceeding 1.96 indicate statistical significance. In this context, it is observed that the transition from bicycle users to motor vehicle users exhibits a statistically significant increase (ab: 3.054). Furthermore, when considering the critical ratios for differences between variables based on the analysis results, it was established that the road coefficients obtained from bicycle users differ significantly from those obtained from motor vehicle users. In other words, the user type plays a meaningful regulatory role within the structural model. To be precise, the road coefficients derived from motor vehicle users surpass the road coefficients derived from bicycle users, and this increase is statistically significant. Consequently, the pertinent hypothesis was deemed valid and accepted.

4. CONCLUSION

As a culmination of this research, a comprehensive questionnaire comprising a total of 56 inquiries was administered. The primary objective was to assess the attitudes and behaviors of both Bicycle Users and Auto Drivers towards each other, gauge their levels of satisfaction, and delve into the issues associated with driver conduct within mixed traffic scenarios. Subsequently, following an examination of the content and meaning of the items within the factors, appropriate factor names were assigned. Subsequent to the application of Confirmatory Factor Analysis (CFA) utilizing the IBM, SPSS Statistics, and SPSS AMOS (Graphics) programs, it was ascertained that the model data exhibited an adequate fit in accordance with the model fit indices obtained.

Individuals residing in the Balkh region tend to favor motorized modes of transportation, specifically automobiles and buses, for their daily commuting needs. This prevalent transportation choice has led to various challenges, including traffic congestion, insufficient parking facilities, air pollution, and visual pollution. Encouraging the adoption of bicycles among the populace holds the potential to alleviate some of these issues to a certain extent.

The residents of Belh predominantly utilize bicycles both for transportation purposes and as a means of engaging in physical activity and sports. This dual role of the bicycle, encompassing transportation and sporting activities, significantly influences its utilization for daily commutes within urban traffic. However, recognizing the bicycle as a viable mode of transportation holds the potential to replace conventional transportation vehicles and enhance its role in urban transportation.

The majority of individuals who incorporate bicycles into their daily routines perceive them primarily as a mode of transportation. Encouraging sports and recreational cyclists to utilize their bicycles for daily commuting can contribute to an augmentation of the bicycle's presence in urban transportation, fostering a synergistic blend of transportation, leisure, and sporting activities.

The prevailing sentiment among individuals who opt for cycling as their mode of transportation prioritizes safety. Specifically, people tend to emphasize the safety aspect when choosing their preferred mode of transportation, particularly parents who prioritize the safety of their children when commuting to school. The provision of dedicated and secure bicycle lanes, distinct from motor vehicle lanes, serves as an effective means to alleviate these safety concerns among the populace and promote increased bicycle usage.

Based on the responses provided by survey participants, it was noted that significant shifts in the attitudes and behaviors of both cyclists and car drivers predominantly occur when traversing intersections. This phenomenon is particularly prevalent during peak traffic periods, such as the morning and evening rush hours, wherein car drivers often exhibit these behaviors towards cyclists. A substantial portion of the residents residing in the central district of Belh expressed dissatisfaction with certain inconveniences experienced in mixed traffic scenarios. They advocated for the implementation of segregated bicycle lanes and separate automobile lanes to address these concerns.

In conclusion, it is imperative to underscore that the successful integration of bicycle and public transportation systems extends beyond the mere establishment of requisite infrastructure and physical measures. It necessitates active engagement through supportive initiatives and well-conceived plans for socio-cultural endeavors. Additionally, it is vital to disseminate information to urban residents regarding the advantages of cycling and to orchestrate educational programs. Furthermore, within the ambit of urban traffic management, policies should be enacted to curtail vehicular usage through economic and supportive incentives, concurrently fostering the adoption and promotion of the bicycle transportation system.

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