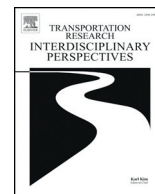




Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: <https://www.journals.elsevier.com/transportation-research-interdisciplinary-perspectives>

Analyzing the influence of social, cultural, behavioral traits on cycling and walking in Pakistan

Suddiyas Nawaz, Yousaf Ali *

Department of Management Science & Humanities, Ghulam Ishaq Khan Institute of Engineering Sciences & Technology, Topi, Swabi, KPK, Pakistan

ARTICLE INFO

Article history:

Received 19 June 2019

Received in revised form 11 July 2020

Accepted 20 July 2020

Available online 11 August 2020

ABSTRACT

Active modes of transport i.e. cycling and walking leave positive and progressive impacts on health, environment, and society. Despite these positive impacts, the developing, as well as many developed economies of the world, sees limited use of active modes of transport. The limited use can be attributed to active transport, being influenced by various social, cultural, and behavioral traits. Through this research, the influence of various social, cultural, behavioral traits on cycling and walking is to be studied. The paper utilizes Decision-Making Trial and Evaluation Laboratory (DEMATEL) for exploring the link between social, behavioral, cultural traits, and active transport in Pakistan. Findings of the research suggest that from considered social parameters, cycling and walking's image as a socially responsible investment and their role in health and safety influence the use of active transport. Exploiting these two social parameters, the use of cycling and walking can be increased. In addition, from amongst the behavioral parameters considered, economic trends and pace of life have the greatest influence on the adoption of active transport as the main mode of transport. Similarly, from considered cultural parameters, the distribution of masses in rural and urban areas, laws and policies, and spending trends motivate the most in shifting towards active modes of transport.

1. Introduction

Modern times of today have offered people various transportation alternatives such as cars, trucks, buses, Light Commercial Vehicles (LCV), vans, jeeps, tractors, and motorcycles. In many developed as well as emerging economies, other sustainable means of transport such as public transport, cycling and walking are also used. From July 2008 to June 2018, in Pakistan, the number of passenger cars has increased at a smaller rate, whereas the use of 2 and 3 wheelers has shown a significant rise as shown in figure given below.

Increased use of cycling and walking is favored due to various options, such as the provision of incentives to cyclists and the commitment of institutes and workplaces towards active transport. Moreover, the development of quality bicycling infrastructure, different educational initiatives and resources, bike-sharing schemes, secure bicycle storage areas, and theft prevention systems also promote their use (Wilson et al., 2018). Despite these promotional activities and campaigns, the modern world of today sees a comparatively fewer number of people cycling and walking, as seen from the stats shown in Fig. 1. Reduced use of cycling and walking

can be attributed to the fact that it is governed by various behavioral, cultural, and social parameters, as evident from various researches conducted.

According to research conducted in 2014, 14 various variables were studied, using exploratory and confirmatory factor analyses, to develop a successful bicycle policy. The findings of this research suggested that factors such as convenience, danger, vandalism, and facilities need to be considered in promoting the use of active transport (Fernández-Heredia et al., 2014). Similarly, another research was conducted taking the viewpoint of Zhenjiang city. This research relied on 2660 data samples and utilized a hybrid choice model comprising of the integrated discrete choice model and the structural equation model. Through this research, it was demonstrated that various social factors help in developing a positive attitude towards cycling and walking and should be considered for developing a feasible transport policy (Ding et al., 2017). Moreover, another research performed a systematic review of 24 studies and highlighted the impact of social and psychological factors on cycling and walking as the main mode of transportation (Willis et al., 2015).

In modern times of today, issues such as global warming, increased deforestation, alarming levels of pollution (air, water, and noise), excessive

Abbreviations: ANP, Analytic Network Process; BMI, Body Mass Index; CRM, Customer Relationship Management; CSF, Critical Success Factors; DEMATEL, Decision-making trial and evaluation laboratory; GDP, Gross Domestic Product; GHG, Greenhouse gas; GSD, Global Software Development; LCV, Light Commercial Vehicles; MCDM, Multicriteria Decision Making; MTS, Mass Transit System; PV, Photovoltaic; R&D, Research and Development; UK, United Kingdom; US, United States; VIKOR, VlseKriterijumska Optimizacija I Kompromisno Resenje.

* Corresponding author.

E-mail address: yousafkhan@giki.edu.pk (Y. Ali).

<http://dx.doi.org/10.1016/j.trip.2020.100182>

2590-1982/© 2020 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

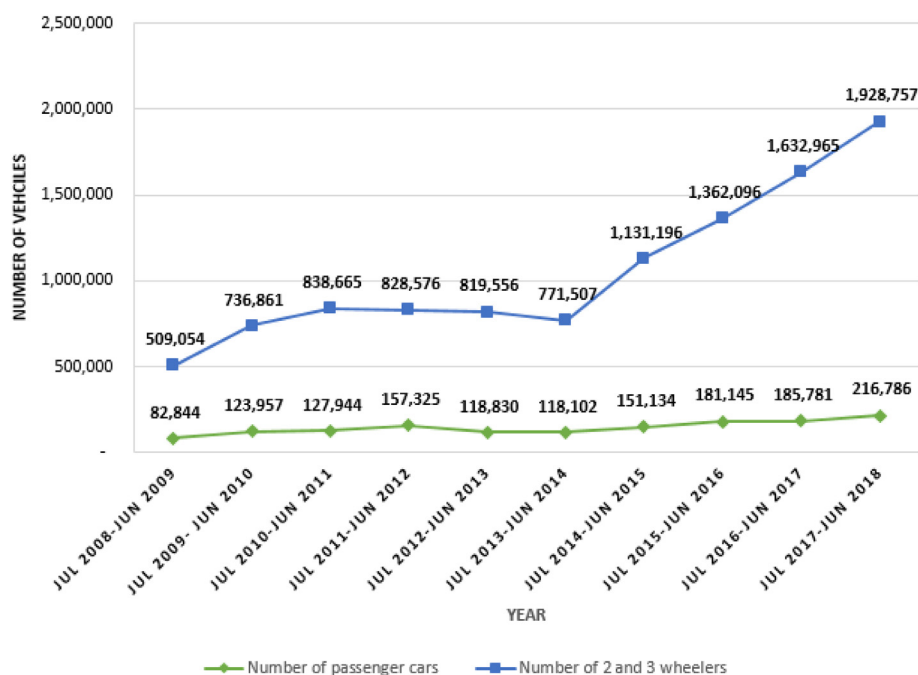


Fig. 1. Number of passenger cars and 2/3 wheelers in Pakistan from July 2008 to June 2018. <https://www.statista.com/statistics/951425/pakistan-sales-volume-of-passenger-cars/>. <https://www.statista.com/statistics/950212/pakistan-production-volume-of-motorbikes/>.

traffic accidents, and deteriorating health conditions of people demand the use of active transport. To promote the use of active modes of transportation, it is necessary to study the influence of different social, behavioral, and cultural parameters on cycling and walking. This research considers this interrelation and aims to achieve two main objectives. Firstly, through this research, we aim to determine which of the three (social, cultural, and behavioral) parameters have the highest influence on active modes of transport. Secondly, using the findings of this research, we want to develop a policy that can allow the adoption of cycling and walking as the main mode of transport.

The research paper is divided into various sections. The first section provides a basic introduction to social, behavioral, cultural factors and highlights the objectives to be achieved through this research. The second section presents a detailed literature review. This section is divided into two main parts; topic-based literature and methodology-based literature. The topic-based literature utilizes the research conducted by various researchers and describes the influence of social, behavioral, and cultural parameters on active transport. The methodology-based literature highlights the methodology used and also shows its applications through past research. Then the methodology to be used i.e. DEMATEL is described. In the next section, the process of data collection is explained. Then, the data analysis section is presented along with the findings. Finally, yet importantly, discussions regarding the final results are presented and the paper is concluded with policy recommendations.

2. Literature review

Numerous researchers, through their research, have shed light on the interrelation between various social, behavioral, cultural factors and active modes of transport. It is highly important to understand this interrelation and use it to develop a feasible transportation policy. This is mainly because a combination of social, behavioral, and cultural factors is what drives the decision-making framework of humans. For instance, the development of proper transport infrastructure cannot guarantee the adoption of cycling and walking as the main mode of transport but a change in lifestyles or people's mindset can assure that.

According to a research conducted in 2018, the use of cycling and walking in the residential neighborhood is mostly influenced by the behavior of individuals and their personality characteristics (Haron et al., 2018). In 2018, research was conducted to show the influence of different social parameters on the preference for active transport. This research comprised of a data sample of 882 adolescents, who were subjected to different physical and social environments. Findings of the result suggested that with a change in social factors, preference towards the use of active transport varied (Verhoeven et al., 2018). Similarly, another group of researchers took a data sample of 40 older adults in Flanders, Belgium, and showed various environmental factors that have a positive influence on cycling and walking. According to the findings of this research, factors such as traffic safety, road design, and maintenance, connectivity and aesthetics play the most important role in preferring cycling and walking (Cauwenberg et al., 2018).

Research published in 2018, took a data sample of 1289 parents and examined the relation between micro-scale environmental factors and children's cycling. The outcomes of this research showed that improvement in factors such as traffic speed and density, road maintenance and evenness, and speed bump, can increase the use of active transport (Ghekiere et al., 2018). Another research, conducted in 2018, developed a case study of Downtown University in Toronto, Canada. The findings of this research suggest that provision of proper bicycle infrastructure; neighborhood environment and sociodemographic factors play a positive role in increasing the use of cycling and walking (Nahal and Mitra, 2018). Similarly, another research emphasized the importance of the physical design of cycling lanes on cycling experience. Through 11 interviews of practitioners from the United Kingdom, Denmark, Germany, Netherlands, and Belgium, it was demonstrated that designing cycling lanes according to the needs of cyclists can increase the adoption of active transport (Liu et al., 2019).

To promote the use of cycling and walking, a group of researchers conducted multivariate logistic regression on a data sample of 1544 employees working in the Netherlands. Through this research, it was shown that different individual, employment-related and psychosocial factors influenced the use of cycling and walking (Adams et al., 2017). Similarly, another research conducted in 2016, highlighted the influence of environmental characteristics such as population density, land use mix, and connectivity on cycling and walking (Saelens et al., 2016). Recently, another research expressed

the influence of travel time, convenience, and avoidance of passive transport on cyclists and pedestrians. Through a data sample of 337 travelers in a university campus, crowding and pedestrians' inattention turned out to be contributing factors (Gkekas et al., 2020).

In 2016, research was conducted to demonstrate that the influence of social, cultural, and behavioral parameters is greater than built-in environmental features. This research took the viewpoint of a university campus in a metropolitan area of Montreal, Canada. Findings of research showed that socio-demographic factors, trip characteristics, effort, and lack of safety act as the most important influencers towards cycling and walking (Manaugh et al., 2016). Similarly, another group of researchers from Bangalore, India demonstrated that social expectations, convenience, and change in attitudes towards active modes of transport help people shift towards them more easily (Verma et al., 2016).

A research considered the influence of psychosocial and environmental factors on active and passive transport. Through the use of zero-inflated negative binomial regression models, it was demonstrated that social customs, structure, and social support were the most influential in promoting active transport (Verhoeven et al., 2016). Moreover, in another research conducted, through an ecological model, it was shown that the parameters such as safety, convenience, and attractiveness motivate people towards the use of active transport (Heesch and Sahlqvist, 2013).

The decision to adopt passive or active modes of transportation is influenced by gender disparity as well. To show the influence of gender disparity on cycling and walking, research has been conducted by taking a data sample of 1862 cyclists from Queensland, Australia. This research employed a collaborative approach of multivariable linear, logistic, and ordinal regression models to show the relationship between gender and cycling motivators and constraints. The findings of this research suggested that men rather than women were more likely to use cycling and walking as the main mode of transport. Moreover, this research also showed that for both genders, personal factors acted as motivators whereas perceived environmental factors acted as constraints towards cycling and walking (Heesch et al., 2012).

Another group of researchers took a data sample of 1197 school students and showed the association between individual, social, environmental parameters, and their influence on cycling to school. Outcomes of this research demonstrated that the location of the school, traffic network in the school's locality, and street network are the main influencing forces towards cycling and walking (Trapp et al., 2011). Moreover, another research employed 70 participants and showed that positive image of cycling and walking act as a facilitator towards the use of active transport (Daley and Rissel, 2011). Another research was conducted by taking a data sample of 2064 students from Norfolk, UK. This research showed that parents' attitudes, safety concerns, and social support have a positive influence on the use of active transport (Panter et al., 2010).

Based on a detailed critical and descriptive literature review, the factors influencing active transport have been divided into 3 main dimensions. The chosen dimensions include social, behavioral, and cultural factors motivating or discouraging the use of active transport (Tables 1–3).

Table 1
Social parameters and their description.

Social parameters	Description
Acceptability	Potential of active transport to be accepted as a viable means of transportation.
General welfare	The tendency of cycling and walking to act as a source of welfare, greater good, and well-being for mankind, environment, and society
Socially responsible investment	Role of the active transport to have positive impacts on health, environment, economy, society, and quality of life.
Health and safety	The propensity of active means of transport to decrease the prevalence of various diseases and reduce the risk of traffic accidents.
Lifestyles	The rate at which the lifestyle of an individual allows for the active means of transport to be accepted.

Table 2
Behavioral parameters and their description.

Behavioral parameters	Description
People's mindset	An individual's philosophy towards life, formulating a major portion of his/her behavior and decision-making.
Pace of life	The pace at which an individual wants to live his/her life (old-school versus modern-day fast-paced).
Economic trends	Trends which define the economy of a nation and shape the economic, social, cultural, and transportation aspects of a nation.
A consistent approach towards life	The decision of people to stick to something they can utilize for a longer duration of time or trying new alternatives.
Attitude towards active modes of transport	Optimistic or pessimistic towards active modes of transport, driven by recent sustainability movement.

To evaluate the influence of different social, behavioral, and cultural parameters on cycling and walking, this research employs Multi-criteria Decision Analysis (MCDA) technique. MCDA techniques are preferred over other decision-making algorithms as they consider the interrelation between various criteria and give the best alternative. For this research, DEMATEL from amongst MCDA techniques has been used.

3. Methodology

To analyze the influence of social, behavioral, and cultural parameters on cycling and walking, this research uses DEMATEL. The DEMATEL approach was firstly proposed by the Battelle Memorial Institute of Geneva in its Science and Human Affairs Program (Gabus and Fontela, 1972).

DEMATEL considers the interrelation between various factors by categorizing them into cause-and-effect groups (Lin, 2013). By dividing the complex and intertwined problems into cause-and-effect groups, DEMATEL makes it possible to realize the causal relation between sub-criteria (Falatoonitoosi et al., 2014). Through a clear representation of direct or indirect relations amongst various factors, the quality of interrelations amongst the group is promoted (Shahraki and Paghaleh, 2011). It allows evaluating the interrelations amongst the group to find critical factors through a visual structural model or digraph plot (Si et al., 2018). Different social, behavioral, and cultural parameters are the causes which motivate or discourage the effect of cycling and walking. This link makes it a cause-and-effect relation and justifies the use of DEMATEL.

However, it is to be kept in mind that DEMATEL despite multiple advantages offers some limitations as well. In contrast with other MCDA techniques, it determines the ranking of alternatives based on their interrelationship without taking the criteria in the account. Moreover, in summing the personal judgments of experts in group assessments, the relative weights of experts are not taken into consideration in DEMATEL (Si et al., 2018). The DEMATEL technique can be implemented by following the steps given below (Tzeng and Huang, 2011).

Table 3
Cultural parameters and their description.

Cultural parameters	Description
Gender disparity	Acknowledging that genders are not equal, which affects one's life decisions.
Laws and policies	The rate at which legislation and policy-making have been done to motivate or discourage the use of active transport.
Spending trends	Patterns, which shape the budget of an individual's budget.
Values and attitudes	Broader and preferable set-of-actions, which can formulate personality and help in decision-making.
Rural versus urban distribution	The percentage at which the population is divided into different areas, defining the transportation and cultural trends.

3.1. Steps in DEMATEL

3.1.1. Step 1

In this step, an initial relation matrix is developed. To formulate this matrix, we use a scale of 0, 1, 2, and 3, signifying no influence, low influence, medium influence, and high influence respectively. To form this matrix, we rely on the data collected from experts in the form of matrices. Through these matrices, the relative effect of factor *i* on factor *j* is recorded. Using the collected data, an average matrix is calculated. Notation x_{ij} represents how much factor *i* affects factor *j*. The diagonal elements of the matrix (*i* = *j*) do not influence each other, hence represented by “0”. An “*n* × *n*” matrix is constructed for each participant, represented as $x^k = x_{ij}$ where *k* represents the total number of participants $1 \leq k \leq n$ and “*n*” represents the total number of participants. The average matrix is calculated as shown in Eq. (1).

$$\text{Average matrix (a)} = \frac{1}{n} \sum_{k=1}^n x_{ij}^k \quad (1)$$

3.1.2. Step 2

In this step, we calculate the normalized initial matrix. It is calculated by normalizing the average matrix. Normalized initial matrix (N) is calculated as follows:

$$N = s * (\text{average matrix}) \quad (2)$$

where,

$$s = \left[\frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}} \right] \quad (3)$$

3.1.3. Step 3

After the normalized initial matrix is calculated, the next step is to calculate the total influence matrix (T). It is calculated using the following formula:

$$T = N * (I - N)^{-1} \quad (4)$$

In the formula represented above, *I* represent an identity matrix and *N* is the normalized initial matrix. After calculating the total influence matrix, calculate the sum of each row and column. R_i represents the sum of rows while C_j represents the sum of columns. Determine $(R_i + C_i)$ and $(R_i - C_i)$ after calculating the sum and difference of rows and columns respectively. $(R_i + C_i)$ is also known as “Prominence” whereas $(R_i - C_i)$ is also known as “Relation” (Falatoonitoosi et al., 2013). $(R_i + C_i)$ value denotes the importance of factor *i*, where larger values denote greater importance and vice versa. $(R_i - C_i)$ denotes the net effect of factor *i* on other factors. A positive value indicates that factor *i* is a net cause influencing other factors. A negative value signifies *i* as a net receiver or net effect as it is influenced by other factors (Yang et al., 2013).

3.1.4. Step 4

Calculate a threshold value from the matrix “T”. The threshold value helps to filter out the factors with negligible effects. The threshold value is calculated by computing the average of all elements in matrix T. After calculating the threshold values, we develop digraphs by plotting $(r_i + c_i)$ vs $(r_i - c_i)$.

4. Data collection

To collect and analyze data, this research paper relies on a quantitative approach. The quantitative approach is preferred over qualitative as it allows the use of mathematical models and also avoids the risk of manipulated and directed outcomes. For quantitative research, a survey questionnaire

was developed. The questionnaire comprised of three 5×5 matrices, one for each, social, cultural, and behavioral traits. The questions inquired about the status of the influential relationship between different social, behavioral, cultural factors, and cycling and walking. To show this relation, respondents were given the option to select from a range of 0–3, where 0 meant no influence, 1 showed less influence, 2 represented medium influence and 3 showed the highest influence.

To guarantee data accuracy and mitigate human-error, the questionnaire was supported through data validation. Distribution of the questionnaire amongst a stratified data sample of 40 psychology professionals, academics, and researchers, helped improve the quality of normally-distributed data. To ensure that DEMATEL is valid, the sum of the column values of the normalized initial direct-relation matrix is to be determined. If the sum is less than one (as in our case), DEMATEL is found valid and vice versa. For ensuring the reliability of results, we check the D^∞ matrix, which should be null. If we get a non-null matrix, the T-matrix cannot be obtained because of non-convergence. In that case, the DEMATEL is infeasible and produces unreliable results. In our case, the D matrix for each factor converges, giving reliable results (Ranjan et al., 2016).

5. Results

The adoption of active transport has positive impacts on health, environment, society, and quality of life (Nawaz and Ali, 2019). Despite these positive impacts, emerging economies like Pakistan see their limited use. This limited use is due to various social, behavioral, and cultural factors. This research, employing DEMATEL, shows us the social, behavioral, and cultural factors which provide the maximum support in our shift towards active modes of transport. Firstly, the average matrices for social, behavioral, and cultural parameters are formulated. After the determination of the normalized relation matrix, we determine the total influence matrix (T) for social, behavioral, and cultural parameters. After that, we determine the Prominence and Relation value for each of social, behavioral, and cultural as shown in Tables 4–6.

6. Discussions

6.1. Social parameters

The social parameters ranked the most influential in shifting towards active transport include the status of cycling and walking as a socially responsible investment and the role, it plays in promoting health and safety. Based on the values of Relation, these two parameters are the causes of the shift towards active transport. On the other hand, parameters such as acceptability, general welfare, and lifestyle are the effects of these variables. Since these 3 social parameters are the effect variables and do not have a direct influence over one another, they are invalid as influencers.

Cycling and walking's status as a socially responsible investment has the greatest role in the adoption of active transport. The switch from passive to active modes of transport helps in decreasing the level of greenhouse gas (GHG) emissions. With a decrease in GHG emissions, the level of smog and acid rain is reduced. Moreover, adapting active transport, leads to lowered issues of deforestation and loss of habitat, saving numerous species from the brink of extinction. Furthermore, with the adoption of cycling and walking as the main mode of transport, the hazardous levels of air, water, and noise pollution can be decreased. The drastic reduction in various

Table 4

Ri + Ci and Ri-Ci of social parameters.

	Ri + Ci (prominence)	Ri-Ci (relation)	Ranking
Acceptability	5.169	−1.474	–
General welfare	4.322	−0.339	–
Socially responsible investment	4.974	1.098	1st
Health and safety	4.367	1.032	2nd
Lifestyles	5.144	−0.318	–

Table 5

Ri + Ci and Ri-Ci of behavioral parameters.

	Ri + Ci (prominence)	Ri-Ci (relation)	Ranking
People's mindset	4.265	-0.355	–
Pace of life	4.231	1.322	2nd
Economic trends	4.487	1.445	1st
A consistent approach towards life	4.557	-1.202	–
Attitude towards active modes of transport	4.342	-1.211	–

Table 6

Ri + Ci and Ri-Ci values for cultural parameters.

	Ri + Ci (prominence)	Ri-Ci (relation)	Ranking
Gender disparity	7.658	-0.376	–
Laws and policies	8.370	0.078	2nd
Spending trends	4.586	0.155	3rd
Values and attitudes	7.681	-0.358	–
Rural versus urban distribution	8.754	0.501	1st

environmental parameters makes cycling and walking a socially responsible investment and influence people towards its use.

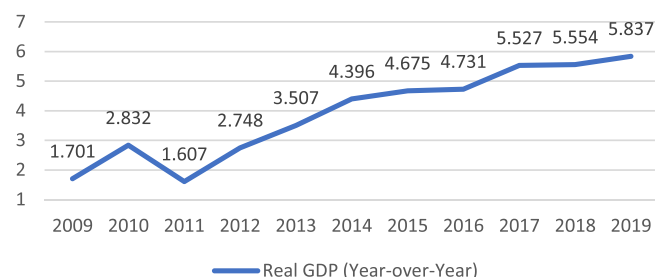
Health and safety offered by active transport is ranked the second most influencing force towards the use of cycling and walking. The use of cycling and walking helps in bringing physical activity and exercise in our daily routine. The inclusion of exercise in our daily life helps decrease the prevalence of various physical and psychological diseases, saving people from premature mortality. Moreover, the use of active transport also helps in decreasing the symptoms and severity of various diseases, leading to a healthier lifestyle. Furthermore, the use of cycling and walking decreases the number of automobiles on the road, provides much safety to cyclists and pedestrians by reducing the number of traffic accidents, increasing the probability of use of cycling and walking.

Acceptability, in this case, is not influencing the use of cycling and walking. Rather, it is being affected by the concept of cycling and walking. This increased acceptability can be attributed to the positive image of cycling and walking, as a socially responsible investment and its staggering impacts on health. With an increase in cycling and walking, people will be able to see beyond the false perceptions affiliated with cycling and walking. The misconceptions related to active transport such as bicycle theft, cyclists being a safety concern for pedestrians, excessive breathing in polluted air due to cycling, impracticality of cycling in metropolitan cities, unsafe cycling infrastructure, etc. can be cleared. This will clear the way for cycling and walking as an acceptable form of transportation and increase its chances for acceptability and adoption.

General welfare is also seen to play no role in influencing cycling and walking. Rather it is being influenced by two causal variables. Other than cycling and walking's positive impact on the health, environment, economy, and society of Pakistan, improvement in the quality of life is also observed. This quality in life can be attributed to factors such as a reduction in traffic congestion, decrement in the stress of meeting deadlines, obstacle-free provision of services, decreased environmental noise, and increased cognitive development of children. To sum up, the increase in the general welfare of the population plays a role as an effect rather than a cause for the adoption of cycling and walking.

Lifestyle choices have shown causal influential link on the adoption of active modes of transport, based on the 2 effectual variables. The leading role of active transport in increasing physical activity, and maintaining a healthy Body Mass Index (BMI) pushes people towards a healthier lifestyle. Moreover, the increased use of active transport influences the lifestyle positively through economic incentives obtained from cycling and walking. The money saved, through active transport, can be used in providing a balanced and organic diet and maintaining an efficient sleep cycle, improving the lifestyle of people. In summary, the lifestyle choices taken by the people appear to be a means to an end for active transportation.

Pakistan's Real GDP

**Fig. 2.** Pakistan's real GDP.

6.2. Behavioral parameters

The behavioral parameters ranked and highlighted the most influential in shifting to active modes of transport include the economic trends persistent in Pakistan and the pace at which Pakistanis tend to live their life. Based on the values of Relation, these two parameters cause the adoption of cycling and walking. On the other hand, parameters such as people's mindset, approach towards life, and attitude towards active transport are the effects, caused by these variables. These 3 behavioral parameters, don't tend to influence one another, hence deemed invalid influencers.

Economic trends have been ranked as the most influential behavioral parameter on the use of active transport. Pakistan's economic trends are always fluctuating and it is estimated that within the next 10 years, Pakistan's economy will collapse (Hoti, 2017). This situation can be contributed to the fact that no foreign investment has entered Pakistan for many years. Moreover, Pakistan's exports have also seen a drastic drop in the last few years. Keeping in view these economic trends, people of Pakistan tend to cut their expenses in each field of life including transportation. One of the best ways to cope up with these decreasing economic trends is the use of cheap and low maintenance transportation alternatives such as cycling and walking. The use of active transport can help people fight these contrasting economic trends and save valuable money in these harsh times.

The pace of life plays the second most influential role in driving people towards the use of cycling and walking. The pace of life defines various important characteristics of an individual's life such as lifestyle, mindset, approach towards life, and decision-making prowess. The pace of life can be old-school or modern-day fast-paced, depending on individual preference, socioeconomic conditions, subjective well-being, and individualism vs. collectivism (Levine and Norenzayan, 1999). The majority of the urban population of Pakistan is suffering from a fast pace of life due to increased competition and pressure to meet the needs of the family (Qidwai et al., 2016). With a faster pace of life, people are inclined towards options that can save them time. This includes, but is not limited to, switching from freshly cooked food to fast or frozen food, using online shopping stores instead of brick-and-mortar shops, and shifting from slower means of transport to faster ones. With an increased pace of life, people are inclined towards the use of passive modes of transport due to their speediness. However, the increased number of automobiles of the road increases the commute times which can be decreased through the use and adoption of active transport.

People's mindset has been found to be influenced by economic trends and pace of life. With the shift in economic trends, people tend to distinguish between their wants and needs. The fulfillment of needs is done following the Maslow Hierarchy of Needs, thus creating a systematic set of priorities in the individual's mind. Subconsciously, through the prioritization of their needs versus their wants, individuals are defining the pace of their life. The volatile economic growth of Pakistan has decreased from GDP growth of 5.83% in FY2018 to 3.33% in FY2019¹ (as shown in Fig.

¹ <https://www.ceicdata.com/en/indicator/pakistan/real-gdp-growth>.

Pakistan's Rural vs Urban Distribution 1955-2020

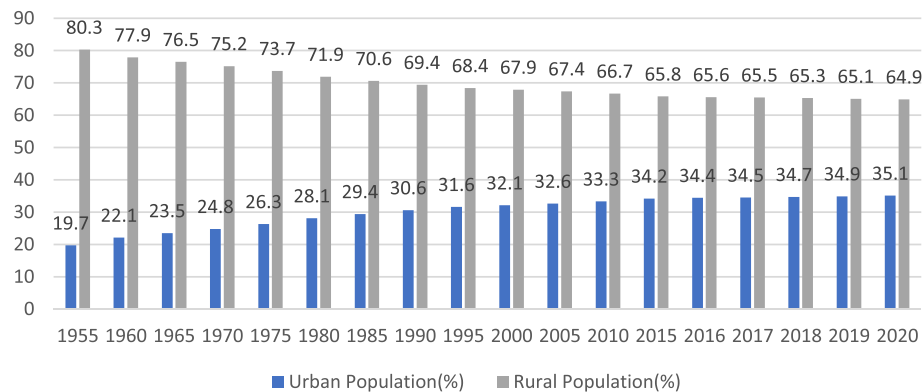


Fig. 3. Pakistan's rural vs urban distribution (Blank et al., 2014).

2 given below). Consequently, the people of Pakistan have been forced to shift towards fulfilling the basic needs and adopting a modest way of living. The attempt to fulfill the basic needs has affected the transportation sector as well, as people have shifted towards cheaper and affordable means of transport such as cycling, walking, and mass-transit systems (MTS).

The approach towards life hasn't shown any influential link on cycling and walking. Rather, it is being influenced by two effectual variables i.e. economic trends and pace of life. With a change in economic stability, the mind subconsciously urges the individual to choose either a consistent or inconsistent approach to life (Berger and Fisek, 2015). People of Pakistan are stuck between two worlds; one that requires a consistent approach towards life and the other that demands variation and adrenaline-filled life. To be a fragment of both, people of Pakistan, tend to live different parts of their life under each of them. When it comes to traveling for vacations or inter-city, people love to travel by automobiles. Whereas for daily tasks such as conveyance to and from work, the use of active transport, 2-wheelers or MTS is preferred. The preference of active transport for daily tasks is evident, as people are confined to a routine and develop transportation habits that help them economically throughout life. Moreover, with the shift to active transport, people are engaged in mindfulness, which makes it easier to be consistent in habits and thoughts.

Attitude towards active transport is a causal factor being affected by economic trends and the pace of life. With an increase in economic spending, the adoption of active transport can help in decreasing transportation costs and vice versa. However, the saving in transportation costs, due to the adoption of active transport have a decisive impact on the pace of life. One of the major barriers faced by active transport in Pakistan includes

difficulty in transporting a large number of passengers and goods, increased travel time and distance to be traveled, which effectively slows the pace of life. In short, the trade-off between decreasing transportation costs and increasing the pace of life is what determines the optimistic versus pessimistic attitude towards active transport.

6.3. Cultural parameters

The cultural parameters ranked and highlighted the most influential in shifting to active modes of transport include the rural vs urban distribution in Pakistan, the existence and implementation of laws and policies, and the spending trends. Based on the values of Relation, these three parameters cause the adoption of cycling and walking. On the other hand, parameters such as gender disparity, and values and attitudes towards active transport are the effects, caused by these variables. These 2 behavioral parameters, don't tend to influence one another, hence deemed invalid influencers.

The distribution of masses in rural and urban areas of Pakistan ranks the most important cultural parameter in the use of cycling and walking. Pakistan has seen a rise in urbanization from 19.7% in 1955 to 35.1% in 2020, to exploit the opportunities cities have to offer (Blank et al., 2014). However, urbanization has led to numerous problems, including high population density, inadequate infrastructure, and lack of psychological adaption (Dociu and Dunarintu, 2012). The lack of psychological adaption promotes the incapacity to meet the faster-paced urban life. To meet the faster-paced life of urban areas, while keeping a check on the transportation costs, people switch from passive to active modes of transportation. The shift from one mode of transportation to another shows that the distribution

Pakistan's Private Consumer Expenditure & Inflation Rate

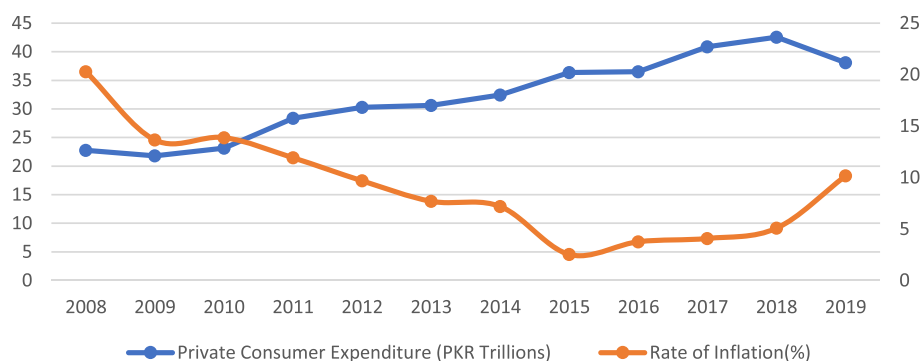


Fig. 4. Pakistan's private consumer expenditure. <https://www.ceicdata.com/en/indicator/pakistan/private-consumption-expenditure>.

Global Gender Gap Index-Pakistan 2020

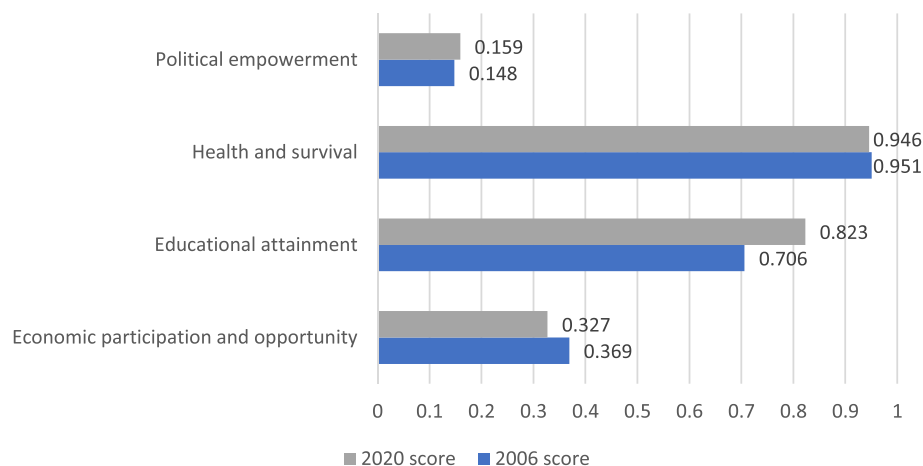


Fig. 5. Global Gender Gap Index-Pakistan 2020 (Schwab, 2019).

of masses according to their location needs to be considered in developing a successful transportation policy (Figs. 3 and 4).

Laws and policies play the second most important role in influencing the use of active transport. The legalization and implementation of proper laws and policies modify behavioral patterns. The presence of laws and policies increases the trust, people have on cycling and walking, which leads to increased acceptance. With the proper rules and regulations, people feel safeguarded against damages caused due to poor or unavailable infrastructure, theft, and accidents. Additionally, the existence of proper rules and regulations can pave the way for active transport policy formulation in workplaces and institutes. Removing these major physical barriers, people can be motivated towards cycling and walking.

Spending trends, have a significant influence on the adoption and use of cycling and walking in Pakistan. After going through various ups and downs in the last decade, the private consumer expenditure in Pakistan has dropped from 42.547 Trillion PKR in 2018 to 38.079 Trillion PKR in 2019.² Moreover, the rate of inflation in Pakistan has seen a drastic increase from 5.078% in 2018 to 10.16% in 2019.³ The decrease in private consumer expenditure, coupled with the increase in inflation, has urged people to spend their money wisely and secure as many savings as possible. Keeping this in mind, people in Pakistan are focused on meeting their necessities only. The same applies to the transportation sector as well, as the people have been inclined towards the option of cycling and walking as a cheap and feasible alternative.

With negative values of Relation, gender disparity does not show any influence on the use of active transport. Rather, it is being influenced by other causal variables (rural vs urban distribution in Pakistan, the existence and implementation of laws and policies, and the spending trends). According to the World Economic Forum's 2020 report, from Pakistan's population of 212.2 million, 103 million are female. Despite having 48.54% female population, Pakistan ranked 151 from amongst 153 benchmarked countries on the Global Gender Gap Index in 2020. Based on economic participation and opportunity, educational attainment, health and survival, and political empowerment, Pakistan has dropped from 112th, 110th, 112th, and 37th to 150th, 143rd, 149th and 93rd positions in 2020 respectively (based on individual scores shown in Fig. 5 given below) (Schwab, 2019).

Gender disparity across Pakistan can be attributed to a cultural mindset of parochialism, suppression of women, narrow-mindedness, illiteracy, and religious misconceptions (Raza and Murad, 2010). Moreover, the indifference of masses and political liberals reinforcing the patriarchal power

structure under the robe of women empowerment programs, are also to be blamed (Ghori, 2018). These variables tend to affect each aspect of our society ranging from education, business, and industry to transport. The cultural norms and social taboos in Pakistan don't allow women of all ages, social classes, and educational backgrounds to choose active modes of transport. However, this changes with education, social class, and rural vs urban distribution in Pakistan. Owing to increased mass-education to remove religious and cultural misconceptions, enhanced social awareness, and urbanization, the issue of gender disparity can be resolved, leading to additional acceptance of active transport.

Values and attitudes, with a negative value of Relation, is another effectual variable being influenced by rural vs urban distribution in Pakistan, the existence and implementation of laws and policies, and the spending trends. Social values set the approach of an individual towards his/her life (pessimistic, optimistic, realistic). Moreover, they help in decision-making, increasing the effectiveness and acceptance of the taken decision (Gorton, 1979). Social values also aid in guiding our behavior, formulating our attitudes. Due to increased urbanization in recent years, people of Pakistan have been influenced by the western values and attitudes and have shown interest in imitating cycling infrastructure models of Netherlands and Denmark. Moreover, the legalization and implementation of laws and policies can also help in eliminating the misconceptions, build an air of trust, and aid the acceptance of active transport. Finally, offering reduced transportation costs through the adoption of active transportation can positively alter Pakistan's cost-centered consumer's attitude towards active transportation.

The study of the influence of social, cultural, and behavioral parameters on active transport can shed light on the adoption of cycling and walking on a massive scale. The removal of physical barriers and the development of proper cycling infrastructure can allow the people to shift to active transport. However, the major hindrance that needs to be looked upon is the amalgamation of social, cultural, and behavioral parameters prevalent in Pakistani society.

Analyzing the association between social, cultural, and behavioral parameters and active transport, it can be seen that the adoption of active transport as the main mode of transport demands a change in people's mindsets. The shift in people's mindsets, values, and attitudes can be achieved through proper educational campaigns, awareness seminars, and behavioral workshops. Also, to help people shift economically towards active travel, incentives can be given through bike-sharing schemes and economic bicycle buying schemes. Moreover, to promote the use of cycling and walking in both genders, gender stereotypes need to be dealt with. The cultural taboos and religious misogyny need to be addressed through mass-education and gender-empowerment programs. Finally, yet importantly,

² <https://www.ceicdata.com/en/indicator/pakistan/private-consumption-expenditure>.

³ https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2018&locations=PK&most_recent_year_desc=true&start=1960&view=chart.

legalization and implementation of proper traffic rules and regulations is to be ensured. Not only will this help build trust in active transport, but it will also help people move towards them without hesitation and risk.

Talking about theoretical implications, we can say that this research paper, for the first time, has presented an influential link between social, behavioral, and cultural factors and active transport. Through proper work on this area, a link can be found between social, behavioral, and cultural factors and passive transport, as well. From an academic perspective, this study shows collaborative research in the fields of transportation management, organizational behavior, and human psychology from the case viewpoint of Pakistan. Through a strong emphasis on these areas, researchers from Pakistan and other emerging countries can explore how the impact of human behavior, cultural norms, and social norms is affecting changes in the transport sector of emerging economies.

The research, however, is subject to a few limitations. The key limitations faced in this research paper include the lack of previous studies, the limited sample size of 40 respondents, the use of a stratified sampling technique, and the lack of criteria interdependency in DEMATEL. To address these limitations, this paper can be used as a framework for working on this interrelation for future research. Moreover, the sample size can be increased to observe a significant statistical relationship between different variables. Using a stratified sampling technique requires sufficient knowledge of the sampling frame and the stratification characteristics. In the future, choosing different sampling strategies can help reduce sampling bias and improve accuracy. Furthermore, to address DEMATEL's limitations, prospective researchers need to use DEMATEL in conjunction with other MCDA techniques.

7. Conclusions

Active transport has positive impacts on health, environment, and quality of life. Through the inclusion of cycling and walking in our daily life, a drop in prevalence and severity of various diseases can be achieved. From an environmental perspective, the shift from automobiles to active transport decreases the alarming levels of GHG emissions and the production of smog and acid rain. Furthermore, the use of cycling and walking results in traffic optimization, leading to lesser commute times, thus giving people some quality in their lives.

Through DEMATEL, the research undertaken highlights the influence of social, behavioral, and cultural parameters on the use of active modes of transport. Findings of the research suggest that from considered social parameters, cycling and walking's image as a socially responsible investment and its role in health and safety influences the use of active transport. The positive image of cycling and walking is boosted because of its direct impacts on health and the environment. Moreover, the societal impact of active transport in terms of reduced accidents and decreased road rage can also pave the way for its increased use. Exploiting these two social parameters, the use of cycling and walking can be increased.

In addition, from amongst the behavioral parameters considered, economic trends and pace of life have the greatest influence on the adoption of active transport. The economic trends tend to have an impact on each decision of human life, ranging from the food we eat to the type of clothes we wear. Likewise, these economic trends affect our mode of transportation as well. In a developing economy like Pakistan, the majority of the middle-class population looks for cost-effective alternatives in transportation, compelling the use of cycling and walking. Similarly, from considered cultural parameters, the distribution of masses in rural and urban areas, laws and policies, and spending trends motivate the most in shifting towards active modes of transport.

CRedit authorship contribution statement

Suddiyas Nawaz:Methodology, Data curation, Formal analysis.
Yousaf Ali:Conceptualization, Validation, Supervision, Writing - review & editing.

References

- Adams, E., Eslinger, D., Taylor, I., Shera, L., 2017. Individual, employment, and psychosocial factors influencing walking to work: implications for intervention design. *PLoS One* 1–14 e0171374.
- Berger, J., Fisek, M., 2015. Consistent and Inconsistent Social Characteristics and the Determination of Power and Prestige Orders.
- Blank, J., Clary, C., Nichiporuk, B., 2014. Drivers of Long-term Insecurity and Instability in Pakistan: Urbanization. RAND Corporation.
- Cauwenberg, J.V., Clarys, P., Bourdeaudhuij, I.D., Ghekiere, A., Geus, B.d., Owen, N., Deforche, B., 2018. Environmental influences on older adults' transportation cycling experiences: a study using bike-along interviews. *Landsc. Urban Plan.* 37–46.
- Daley, M., Rissel, C., 2011. Perspectives and images of cycling as a barrier or facilitator of cycling. *Transp. Policy* 211–216.
- Ding, C., Chen, Y., Duan, J., Lu, Y., Cui, J., 2017. Exploring the influence of attitudes to walking and cycling on commute mode choice using a hybrid choice model. *J. Adv. Transp.* 2017, 1–8.
- Dociu, M., Dumarintu, A., 2012. The socio-economic impact of urbanization. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, pp. 47–52.
- Falatoonitoosi, E., Leman, Z., Sorooshian, S., Salimi, M., 2013. Decision-making trial and evaluation laboratory. *Res. J. Appl. Sci. Eng. Technol.* 5 (13), 3476–3480.
- Falatoonitoosi, E., Ahmed, S., Sorooshian, S., 2014. Expanded DEMATEL for determining cause and effect group in bidirectional relations. *Sci. World J.* 2014.
- Fernández-Heredia, A., Monzón, A., Jara-Díaz, S., 2014. Understanding cyclists' perceptions, keys for a successful bicycle promotion. *Transp. Res. A Policy Pract.* 1–11.
- Gabus, A., Fontela, E., 1972. World Problems, an Invitation to Further Thought Within the Framework of DEMATEL. Science and Human Affairs Program. Battelle Geneva Research Center, Geneva, Switzerland.
- Ghekiere, A., Deforche, B., Bourdeaudhuij, I.D., Clarys, P., Mertens, L., Cardon, G., ... Cauwenberg, J.V., 2018. An experimental study using manipulated photographs to examine interactions between micro-scale environmental factors for children's cycling for transport. *J. Transp. Geogr.* 30–34.
- Ghori, S., 2018, December 23. Pakistan gender disparities: where did we go wrong?. Retrieved from Daily Times. <https://dailymtimes.com.pk/336251/pakistan-gender-disparities-where-did-we-go-wrong/>
- Gkekas, F., Bigazzi, A., Gill, G., 2020. Perceived safety and experienced incidents between pedestrians and cyclists in a high-volume non-motorized shared space. *Transportation Research Interdisciplinary Perspectives* 100094.
- Gorton, D., 1979. The role of personal values in decision-making. *Am. Second. Educ.* 57–59.
- Haron, N., Zainol, H., Omar, W.R., 2018. Conceptual framework of built environment factors on cycling behavior among residential neighborhoods. *Environment-Behaviour Proceedings Journal* 7 (3), 331–338.
- Heesch, K.C., Sahlqvist, S., 2013. Key influences on motivations for utility cycling (cycling for transport to and from places). *Journal of Australia* 227–233.
- Heesch, K.C., Sahlqvist, S., Garrard, J., 2012. Gender differences in recreational and transport cycling: a cross-sectional mixed-methods comparison of cycling patterns, motivators, and constraints. *Int. J. Behav. Nutr. Phys. Act.* 106.
- Hoti, I., 2017. Contrasting trends in Pakistan's economy. Retrieved April 22, 2018, from. <https://tribune.com.pk/story/1288527/perplexing-contrasting-trends-pakistans-economy/>.
- Levine, R.V., Norenzayan, A., 1999. The pace of life in 31 countries. *J. Cross-Cult. Psychol.* 178–205.
- Lin, R., 2013. Using fuzzy DEMATEL to evaluate the green supply chain management practices. *J. Clean. Prod.* 32–39.
- Liu, G., Brömmelstroet, M.T., Krishnamurthy, S., Wesemael, P.v., 2019. Practitioners' perspective on user experience and design of cycle highways. *Transportation Research Interdisciplinary Perspectives* 100010.
- Managh, K., Boisjoly, G., El-Geneidy, A., 2016. Overcoming barriers to cycling: understanding frequency of cycling in a university setting and the factors preventing commuters from cycling on a regular basis. *Transportation* 871–884.
- Nahal, T., Mitra, R., 2018. Factors Contributing to Winter Cycling: Case Study of a Downtown University in Toronto, Canada. *Transportation Research Board 97th Annual Meeting*, Washington DC pp. 18-02858.
- Nawaz, S., Ali, Y., 2019. Impacts of cycling and walking on health, environment, and society: Pakistan a case in point. *International Journal of Ecological Economics & Statistics* 111–136.
- Panter, J.R., Jones, A.P., Sluijs, E.v., Griffin, S.J., 2010. Attitudes, social support, and environmental perceptions as predictors of active commuting behaviour in school children. *J. Epidemiol. Community Health* 41–48.
- Qidwai, W., Khushk, I.A., Shamim, U., Altaf, S., Hadi, H., Nanji, K., 2016. Fast pace of life and its impact on health: results of a study from the largest city of Pakistan. *Pakistan Journal of Public Health* 10–16.
- Ranjan, R., Chatterjee, P., Chakraborty, S., 2016. Performance evaluation of Indian Railway zones using DEMATEL and VIKOR methods. *Benchmarking, An International Journal*, pp. 78–95.
- Raza, A., Murad, H.S., 2010. Gender gap in Pakistan: a socio-demographic analysis. *Int. J. Soc. Econ.* 37 (7), 541–557.
- Saelens, B.E., Sallis, J.F., Frank, L.D., 2016. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Ann. Behav. Med.* 80–91.
- Schwab, K., 2019. Global Gender Gap Report 2020. World Economic Forum.
- Shahraki, A., Paghaleh, M.J., 2011. Ranking the voice of customer with fuzzy DEMATEL and fuzzy AHP. *Indian J. Sci. Technol.* 1763–1772.

- Si, S.-L., You, X.-Y., Liu, H.-C., Zhang, P., 2018. DEMATEL technique: a systematic review of the state-of-the-art literature on methodologies and applications. *Math. Probl. Eng.* 2018.
- Trapp, G.S., Giles-Corti, B., Christian, H.E., Bulsara, M., Timperio, A.F., McCormack, G.R., Villaneuva, K.P., 2011. On your bike! A cross-sectional study of the individual, social and environmental correlates of cycling to school. *Int. J. Behav. Nutr. Phys. Act.* 123.
- Tzeng, G., Huang, J., 2011. *Multiple Attribute Decision Making: Methods and Applications*. CRC Press.
- Verhoeven, H., Simons, D., Van Dyck, D., Van Cauwenberg, J., Clarys, P., De Bourdeaudhuij, I., de Geus, B., Vandelandotte, C., Deforche, B., 2016. Psychosocial and environmental correlates of walking, cycling, public transport and passive transport to various destinations in Flemish older adolescents. *PloS one* 11 (1), 1–19.
- Verhoeven, H., Ghekiere, A., Cauwenberg, J.V., Dyck, D.V., Bourdeaudhuij, I.D., Clarys, P., Deforche, B., 2018. Subgroups of adolescents differing in physical and social environmental preferences towards cycling for transport: a latent class analysis. *Prev. Med.* 70–75.
- Verma, M., Rahul, T., Reddy, P.V., Verma, A., 2016. The factors influencing bicycling in the Bangalore city. *Transportation Research Part A, Policy and Practice*, pp. 29–40.
- Willis, D., Manaugh, K., El-Geneidy, A., 2015. Cycling under influence: summarizing the influence of perceptions, attitudes, habits, and social environments on cycling for transportation. *Int. J. Sustain. Transp.* 9 (8), 565–579.
- Wilson, O., Vairo, N., Bopp, M., Sims, D., Dutt, K., Pinkos, B., 2018. Best practices for promoting cycling amongst university students and employees. *J. Transp. Health* 9, 234–243.
- Yang, Y.-P.O., Shieh, H.-M., Tzeng, G.-H., 2013. A VIKOR technique based on DEMATEL and ANP for information security risk control assessment. *Inf. Sci.* 482–500.