AN ASSESSMENT OF IMPACT OF TRAVELING ON COMMUTER'S HEALTH THROUGH GIS TECHNIQUES: A CASE-STUDY OF LAHORE-PAKISTAN

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ABSTRACT: Traveling is a pleasant activity for leisure time. In daily routine, it is cumbersome, tiring and badly affects the traveler's health. The present study aimed to examine the role of long distance travelling on the health of the commuters working in Lahore City of Pakistan using GIS techniques. Both Primary and secondary sources were used for data collection. Interpolation, weighted sum overlay analysis was performed through Arc Map 10.1. The results revealed that 52% of daily commuters spent 2 to 3 hours to reach their workplace. 22.5 % commuters traveled for 21 to 30 kms and 4.6 % commuter traveled more than 70 kms to reach their workplace. Most common health problems found among commuters were Respiratory 97 %, Eye infections 86%, and central nervous system related problems 69%. The study concluded that commuters from Patoki, Sheikhupura, Renala Khurd, Kasur, Muridke, and Okara were facing more health issues than others. The study recommended examining the role of transport modes in the health deterioration of commuters.

Key words: Commuters, Distance, Interpolation, weighted sum overlay analysis.

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INTRODUCTION

Earning for livelihood has always remained life-time struggle and conditional to travel and movement. Usually, workplaces closer to home are considered ideal but occasionally they can be at a longer distance of several kilometers. Since the industrial revolution, the trend to move to a distant working place became prominent in the world as the high wages started to attract the poor jobless people. They were ready to work as laborers even at far off places towards which they had to travel daily, weekly or sometimes monthly. Commuting is a broad area of research and distant working gives surety of better life-style at the cost of their health and wellbeing. Active commuting is a sign of healthy life-style and contributes towards increased physical activity (Rodriguez *et al.*, 2017). On the other hand, it adversely affects the health of the working class and the daily commuters who spend a reasonable time of the day to reach their workplace (Lovelace *et al.*, 2014). Many researchers have conducted studies to prove the negative effects of the working environment on the health of the workers and labor community for instance a study was carried out to examine the negative health outcomes among long distance travelers in Southern Sweden (Hansson *et al.*, 2011). In another study, the researcher critically reviewed the impact of commuting on human wellbeing and the relevant policy implications and concluded that people traveling for longer distances are more prone to develop lung problems (Chatterjee *et al.*, 2018). A recent study examined the impact of public transport commuting on the mental and physical health of workers. The study identified that mental distress and anxiety was found among those commuters using public buses and traveling for 2 to 3 hours on daily basis (Norgate *et al.*, 2019). According to the report of U.S. Census Bureau, 8.1% of Americans commute every day and spend at least one hour to reach their workplace and vice versa. Almost 600,000 people are commuting at least three hours per day (Anonymous, 2013). Those commuters who travel in peak hours spend more time in the concentration of pollutants and in the low quality air and likely catch more respiratory infections than the commuters who travel in less rush hours (Zuurbier *et al.*, 2011). Time spent in the daily commute matters a lot as it determines the duration of exposure to the pollutant concentration within the vehicle. (Adams *et al.*, 2001). The duration for which the commuters remain exposed in the road traffic environment is very important while considering their health. In general, factors like air quality, type of the pollutants present in the air and the level of concentration can pose health effects. However, short distances and less traveling duration have less harmful impacts on health compared with critical effects of longer exposures. The total time of exposure mainly determines the health problems and their severity (Danielle, 2015; Gulliver *et al.*, 2005). People having long exposure to particulate matter $_{2.5}$ ($PM_{2.5}$) can be victim of different respiratory infections, eye and skin associated diseases. While people who already have some heart or lung problems can be at dangerous point if remain exposed to $PM_{2.5}$ for long durations at high concentration. The PM in the air can cause certain respiratory infections, lung cancer and other health

problems in the urban environments (Urhonen *et al.*, 2016). Road congestion and trip durations are continually increasing in both developed and developing countries yet human health is being confronted with negative direct plus indirect effects. Direct effects are in the form of the toxic gases exposure and road accidents. The indirect effects include declining physical and mental health due to exposure to traffic environment (Wener and Evans, 2011). Keeping in view the above facts and figures the present study aimed to find out the impact of long distance and long duration traveling on the health of commuters who travel to Lahore for work on daily basis.

MATERIALS AND METHODS

Keeping in view the nature of research, primary data sources were used and six sample sites within Lahore (Figure-1) were selected through convenience sampling method useful for non-probability studies, where the subjects were easily accessible (Clifford *et al.*, 2016). The sample sites were mainly the workplaces of the commuters which were as following:

- Mohlanwal Industrial area
- Quaid e Azam Industrial Estate
- Selected Factories on Multan Road
- Lahore Railway Station
- Thokar Niaz Baig
- University of the Punjab, new campus

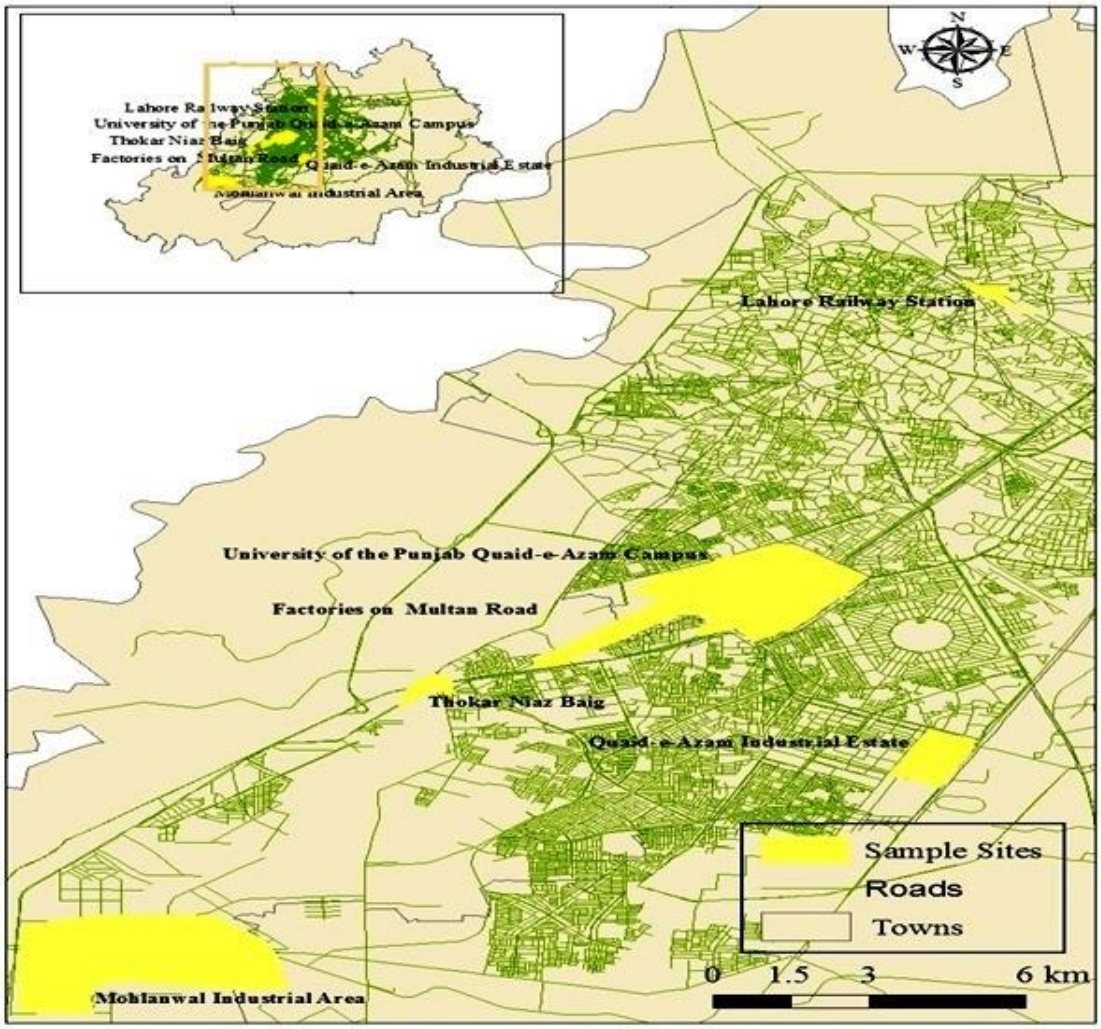

Figure-1: Location of sample sites in Lahore

In order to assess the deterioration of commuter's heath, labor class workers traveling at least one hour or covering a distance up to 10 km daily to reach their workplace were taken as the target population (Norgate *et al.*, 2019). A questionnaire was prepared for acquiring information from the target population. The questionnaire survey was conducted during April to June 2016 and a total of 306 questionnaires were filled by visiting the sample sites personally (Table-1).

Table-1: Questionnaires filled from each sample site

Sr.	Sample sites	Questionnaires
1	Mohlanwal Industrial area	230
2	Quaid e Azam Industrial Estate	37
3	Selected Factories on Multan Road	5
3	Lahore Railway Station	17
4	Thokar Niaz Baig	9
6	University of the Punjab, new campus	8
	Total	306

Source: Field survey (2016)

The gathered data was further arranged and tabulated in SPSS 20. Furthermore, GPS device was also used for taking coordinate positions of the sample sites for mapping purpose. Interpolation, weighted sum overlay analysis was performed through GIS Arc Map 10.1 to see the concentration of health issues reported by the respondents of the study.

RESULTS

The results of the study showed that respondents spent a lot of time in traveling in order to reach their workplace on daily basis. 47% of the respondents spent 1 to 2 hours to reach their workplace. Furthermore, 52% of them spent 2 to 3 hours to reach workplace. However only 1% respondents were those who spent more than 3 hours to reach workplace (Figure-2).

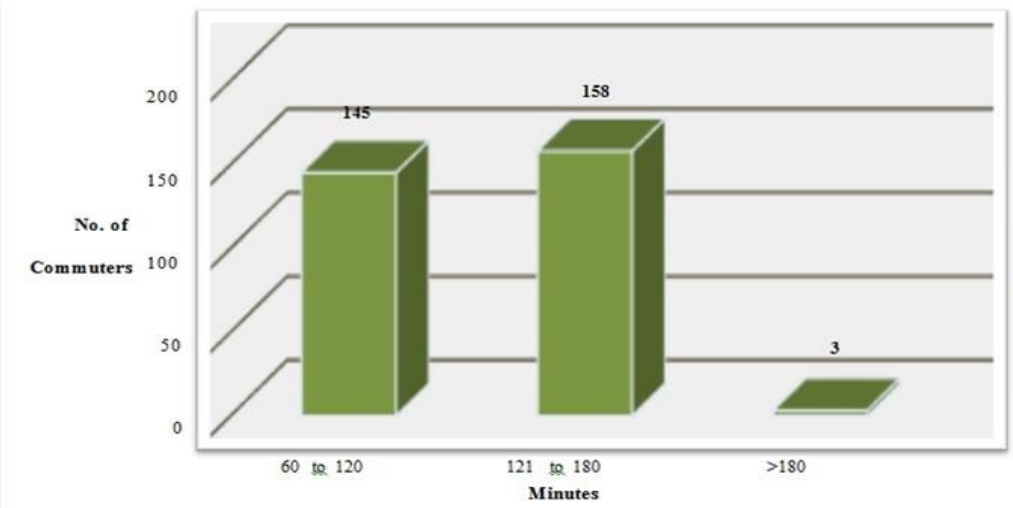

Figure-2: Time spent in travel from home to workplace by commuters

It was also observed that the respondents had to cover quite long distances while traveling to their workplaces. However, great variations were found in the distance covered by them (Table-2).

Table-2: Distance covered by commuters

,Sr.	Distance (km)	No. of commuters	%
1	< 10	13	4.2
2	11 to 20	51	16.7
3	21 to 30	69	22.5
4	31 to 40	49	16.0
5	41 to 50	34	11.1
6	51 to 60	38	12.4
7	61 to 70	38	12.4
8	> 70	14	4.6
	Total	306	100.0

Source: Field survey (2016)

Most of the respondents i.e. 69 were covering distance of 21 to 30 kms to reach their workplace. A reasonable majority of 49 respondents was covering distance of 31 to 40 kms yet only 14 were those who covered more than 70 kms.

The results revealed that the respondents frequently faced different health problems due to long distance and long duration traveling (Table-3).

Table-3: Health problems faced by commuters.

Sr.	Health problems	No.
1	Respiratory problems	297
2	Skin associated problems	165
3	Gastrointestinal problems	76
4	Eye infections	262
5	Ear disorders	85
6	Central nervous system problems	210

Source: Field survey (2016)

The most commonly reported health problem was respiratory problems that had been frequently faced by 297 respondents. The second most commonly reported health problem was eye infections mentioned by 165 respondents. However, the least reported health problems included ear disorders and gastrointestinal problems faced by 85 and 76 respondents respectively. Figure-3 shows the association of distance covered by commuters and resulting health problems.

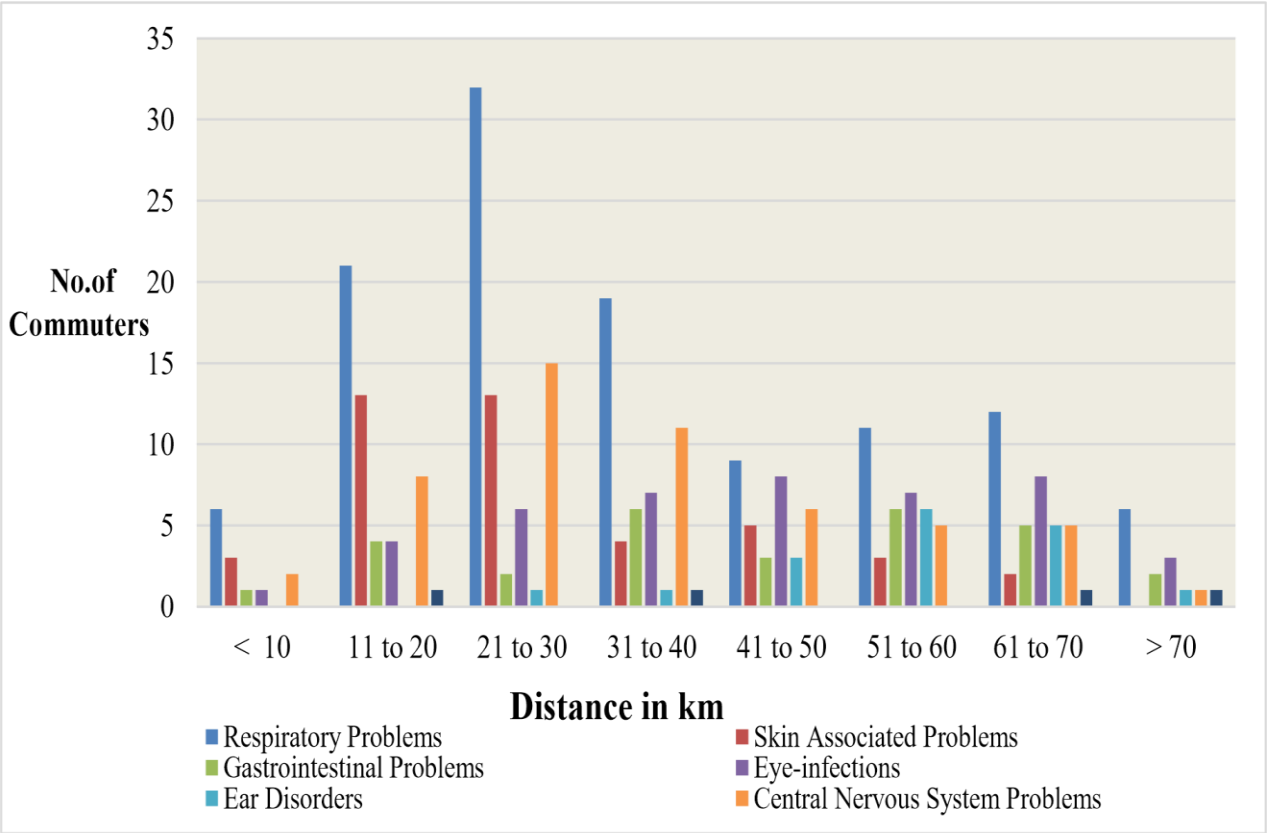

Figure-3: Comparison between distance and commuter's health

Furthermore, maps were created with the theme of health problems reported by respondents and their concentration was shown with respect to their residences. Seven different health problems including respiratory, skin associated, gastrointestinal and central nervous system associated problems, eye-infections, ear Disorder, heat stroke, sun stroke, etc. Figure-4 showed health problems of commuters who were living in different areas and working in Lahore. Out of 306 targeted commuters only nine said that they did not face any travel related health problem. The dominating majority of 297 commuters were facing one or more health associated problems which varied from acute to chronic states. The highest concentration of health problems was found at distant locations like Pattoki, Kasur, Muridke, Sheikhupura and Jandiala Sher Khan. This revealed the fact that commuters from these places had to travel for longer duration and cover more distance to reach their workplace. Consequently, they were facing more health issues than others.

Likewise, the lowest concentration was observed within the urban limits of Lahore city such as Afsar market, Hassan town, Muslim town, Model town, Khokar town, Qanchi, Dharampura etc. This pattern revealed the fact commuters from these places were spending less time in travel and covered less distance. As a result, the concentration of diseases was also low over there.

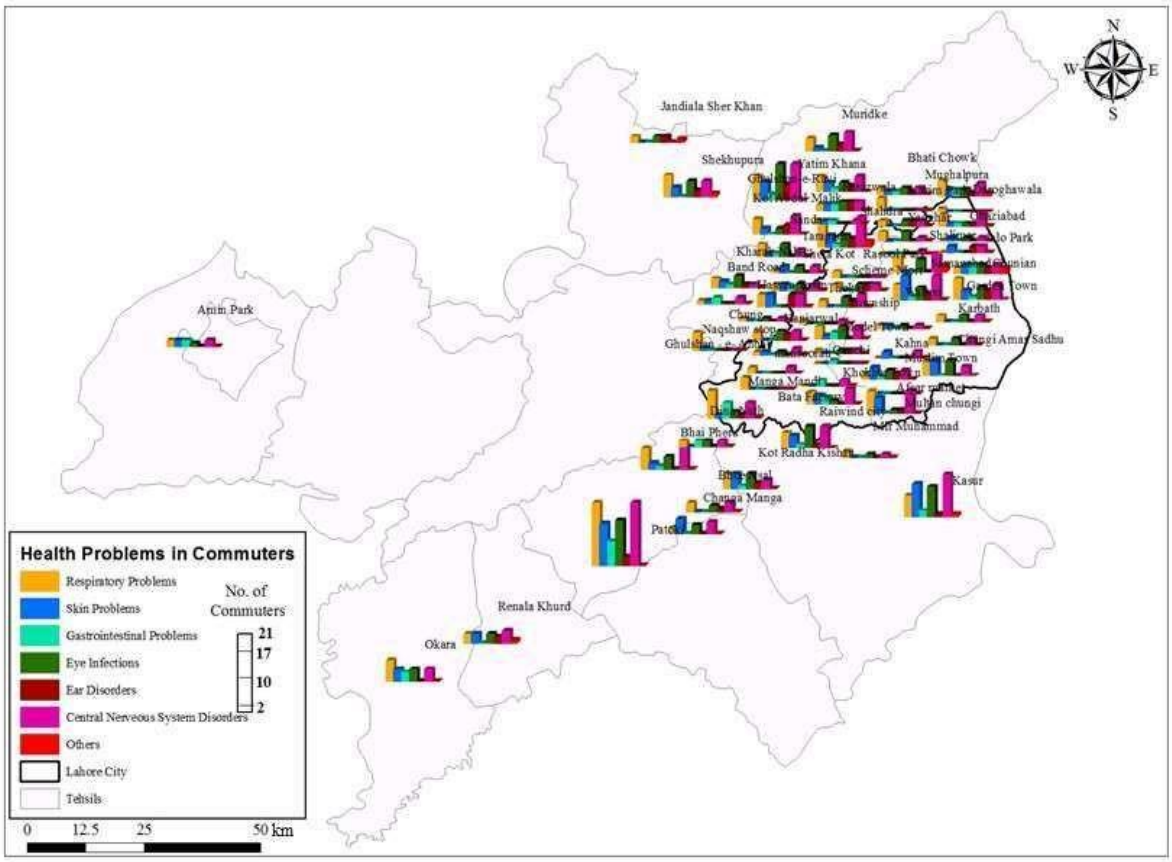

Figure-4: Spatial pattern of health problems faced by commuters

DISCUSSION

Spatial interpolation is an important feature of Geographic Information Systems (GIS) in which sample sites are used for the estimation of the values of un-sampled sites in the spatial interpolation. A GIS based study of exposure of the commuters of Dublin, Ireland to PM was studied by Pilla and Broderick (2015) by using interpolation technique. The study revealed that due to long term exposure to PM, more than 60% of the study participants were found to be suffering from severe respiratory infections.

In present research, Interpolation was used to show the concentration of health problems. An individual raster was created for each health problem (see Figure-5). The raster of respiratory problems showed the highest concentration in the commuters in distant areas of Pattoki, Renala Khurd, Changa Manga, while the areas as Shalimar, Samanabad, Chunian, Thokar, Chung, Model Town showed the lowest concentration of respiratory diseases in commuters. Manga Mandi, Dina Nath, Kot Radha Kishan showed the average concentration representing comparatively less commuters with respiratory diseases there.

In the raster of skin associated problems, the highest concentration was found at Kasur, Patoki, Changa Manga, Kot Radha Kishan, and Yatim Khana. On the other hand, lowest concentration was observed at Walton, Sandha, Ferozwala, Chung and Hanjerwal.

The raster for gastrointestinal problems showed the high concentration at two points i.e. Patoki and Manga Mandi only. However, all other areas exhibited low concentration in this regard.

Similarly, the highest concentration of eye infections was seen at maximum places including Yatim Khana, Patoki, Kasur, Sheikhupura, Muridke and Chungi Amar Sadhu. Hence, low concentration was observed at areas including Walton, Khokar town, Model town, Muslim town, Multan chungi, Chaburji, and Qanchi.

A scattered pattern was observed regarding concentration of ear disorders. However, distant areas like Sheikhupura, Shahdara, Ferozwala and Okara exhibited a moderate concentration of ear disorder. No specific concentration could be observed in the other places.

Central nervous system associated problems were found more frequently and well spread in the study area. Highest concentration was found at Patoki, Kasur, Shahdra, Muridke, Yatim Khana, Smanabad, and Kot

Abdul Malik. Yet, lowest concentration was seen at Kharak nala, Mehmood Boti, Khokar town, Model town, Walton, and Afsar market.

A dispersed pattern was seen for heat stroke, sun stroke and backbone pain. Three small patches were seen at Kasur, Sheikhupura and Renala Khurd. No specific concentration could be observed elsewhere.

For the creation of overlay output the Weighted Sum was performed. Weighted Sum can weight and combine multiple inputs to create an integrated analysis. It was performed by creating a database pivoting on the residences of commuters to find their pattern of health condition. The final presentation highlighted that the commuters living at distant locations from their workplace were generally facing more health problems than the commuters living near to their workplace. On overall basis, Patoki, Renala Khurd, Kasur and Okara were seen under highest concentration of health problems. It clearly revealed that commuters living here were more prone to health issues due to long distance commuting and so on (Figure-5).

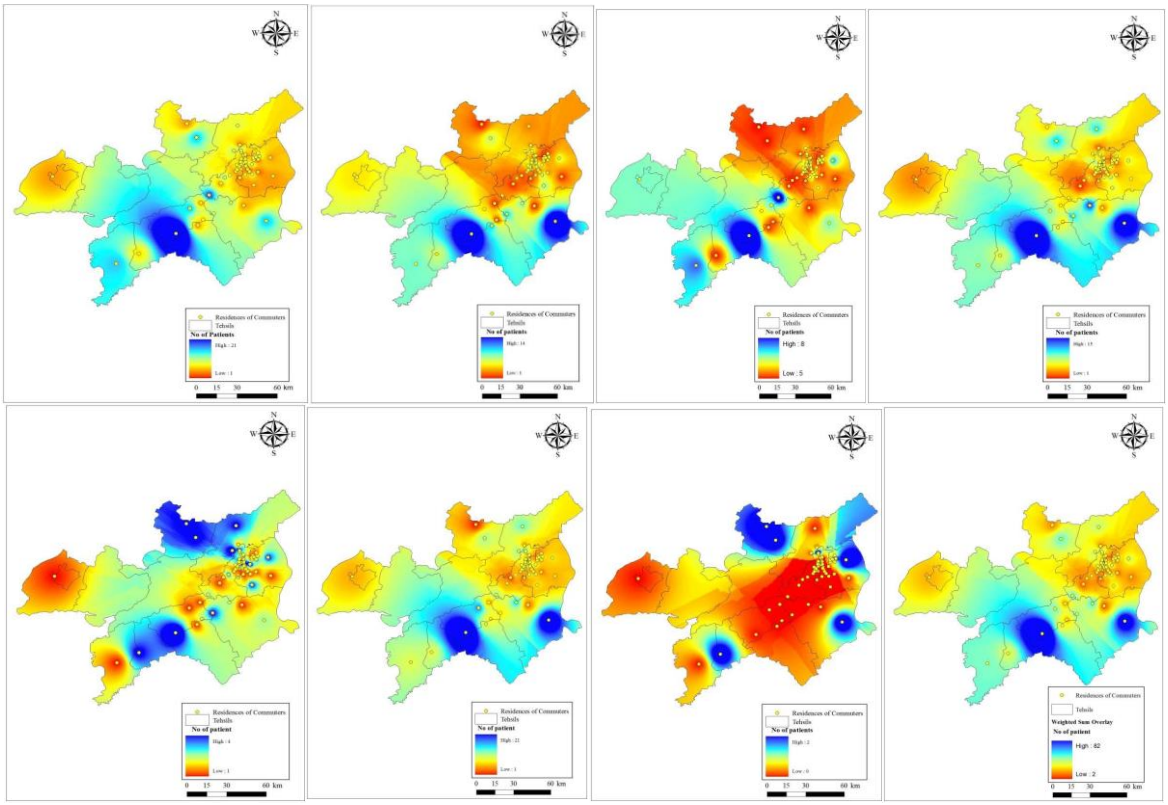

Figure-5: Interpolations of health problems by commuters

Conclusion: It was concluded that long distance traveling from places like Patoki, Sheikhupura, Renala Khurd, Kasur, Muridke, and Okara to Lahore was negatively affecting the health of daily commuters. The study recommends examining the role of transport modes in the health deterioration of daily travelers.

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