

Peak-Hour Road Accessibility and Healthcare Utilization at an Urban Primary Clinic

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Abstract

Access to healthcare facilities is an important factor influencing healthcare utilization. Traffic congestion during peak hours may increase travel time and reduce the comfort and efficiency of reaching healthcare services. This study examined the relationship between peak-hour road accessibility and healthcare utilization decisions at the Primary Clinic of Poltekkes Kemenkes Semarang. A quantitative observational analytic design with a cross-sectional approach was used. The sample consisted of 55 non-emergency patients traveling during peak hours, selected through accidental sampling. Data were collected using closed questionnaires and direct traffic observations on Prof. Soedarto Street and Tirta Agung Street during morning (07:00–08:00 WIB) and afternoon (16:00–17:00 WIB) peak periods. Spearman Rank correlation was applied at a 5% significance level. Most respondents experienced moderate travel time (38.2%), while 40.0% reported never routinely using the clinic. Traffic congestion, on-street parking, and commercial activities reduced effective road capacity and increased travel time by approximately 30–40%, with peak traffic reaching 1,837 pcu/hour. However, travel time was not significantly associated with healthcare utilization decisions ($p = 0.361$; $\rho = 0.125$). Nevertheless, accessibility and supporting facilities affected comfort, travel efficiency, punctuality, and arrival delays. These findings suggest that transportation barriers may affect service experience even without directly determining utilization decisions.

Keywords: Road Accessibility, Health Services, Peak Hour Traffic, Transportation, Travel Time.

I. INTRODUCTION

Accessibility is a crucial factor in the utilization of healthcare services. The ease with which people can reach healthcare facilities can influence their decision to utilize them. Within the concept of healthcare, accessibility relates not only to the availability of healthcare facilities but also to ease of transportation, road conditions, and travel time to the facility. Accessibility barriers can lead to delays in services, reduced patient visits, and even lower healthcare utilization (Kabayundo et al. 2025). The development of urban areas has led to increased mobility and increased traffic volume on roads. This situation has resulted in traffic congestion, particularly during morning and evening peak hours. Traffic congestion increases travel times and reduces the comfort level of road users. In the transportation sector, travel time is a key indicator in measuring the accessibility of a service location. The longer the travel time due to traffic congestion, the lower the level of ease of access to health facilities (Cochran et al. 2022).

Tirto Agung Street is a road in the Tembalang area of Semarang City, with a high level of traffic activity. This area has developed into a center for education, housing, commerce, and public services, resulting in a high daily traffic volume. Research on the capacity analysis of the unsignalized intersection on Durian Raya–Tirto Agung Street shows that at certain times, vehicle volume increases, causing traffic congestion at the intersection. The highest traffic volume occurs during the morning rush hour, with a total traffic flow reaching 1,837 smp/hour. This condition causes increased vehicle delays and the potential for queues at the intersection (Suharyo, Anggraini, and Arthaningtyas 2021).

Jalan Tirto Agung is also directly connected to Jalan Prof. Soedarto, which has a relatively high level of vehicle mobility. This road serves as the main access to educational areas, residential areas, student activity centers, and public service facilities in the Tembalang area. Traffic congestion on Jalan Tirto Agung is also influenced by the high number of people traveling during work and school hours. Another study in the Banyumanik area, Semarang, showed that vehicle density increases significantly between 7:00–8:00 AM and 4:00–5:00 PM WIB, which are peak travel times.

The higher the number of vehicles on the road and intersections, the greater the level of traffic delays that occur (Praharseno 2023). Transportation barriers have been identified as a factor affecting public access to healthcare services. Research shows that transportation barriers can lead to delayed visits, canceled appointments, and low healthcare utilization. Factors such as traffic congestion, limited transportation access, and long travel times contribute to people's decisions about using healthcare facilities (Cochran et al. 2022) and (Smith et al. 2023).

The Semarang Ministry of Health's Poltekkes Primary Clinic, located on Jalan Tirto Agung, is a healthcare facility located in an area with relatively high traffic volume. Increased vehicle traffic during peak hours has the potential to impact public comfort and accessibility to healthcare facilities. This can impact people's decisions about utilizing healthcare services at the clinic. Based on this description, research is needed to determine the relationship between road accessibility during peak hours and the decision to utilize healthcare services at the Primary Clinic of the Ministry of Health Polytechnic of Semarang. This research is expected to provide insight into the influence of traffic conditions on healthcare utilization and serve as evaluation material for improving healthcare accessibility in urban areas.

II. LITERATURE REVIEW

A. Road Accessibility

Accessibility is the level of ease with which a person can reach a specific location or facility. In transportation, accessibility describes the ease of moving from one place to another, influenced

by road network conditions, travel time, distance, and available transportation systems. Accessibility is a crucial indicator in transportation planning because it directly relates to community mobility and the effectiveness of public services (Tamin 2020). Accessibility is not only determined by the distance to a location, but also influenced by travel time, congestion levels, and road user comfort. In urban areas, high traffic volumes often lead to increased travel times, which impacts the quality of regional accessibility (Fauziah et al. 2025). Therefore, road accessibility is an important indicator in transportation and public service planning because it is directly related to the efficiency of community mobility and the quality of services in a region (Riswan et al. 2020).

B. Traffic Conditions during Peak Hours

Traffic is the movement of vehicles and road users on a road within a specific time period, influenced by vehicle volume, road capacity, surrounding area activity, and user behavior. In urban areas, increased mobility leads to an increase in the number of vehicles, triggering traffic congestion, especially during peak hours. High vehicle volumes that are disproportionate to road capacity can reduce the level of road service and cause congestion (Sanjaya et al. 2017; Juliend 2020). Peak hour is the period when traffic volume reaches its highest, typically in the morning when people are leaving for work or school and in the evening when they are returning from their activities. During this period, increased traffic volume often causes congestion, slowdowns, increased travel delays, and increased travel time for road users (Prayitno 2020).

C. Utilization of Health Services

Utilization of health services is the use of health care facilities by individuals and communities to obtain promotive, preventive, curative, and rehabilitative services. Utilization of health services is influenced by various factors, including health needs, service quality, cost, public knowledge, and accessibility to health facilities. Ease of access to health facilities can increase the likelihood of people utilizing health services optimally (Banowati and Nurhasan 2024). Research on the relationship between ease of access and patient satisfaction shows that ease of access to healthcare facilities is significantly related to satisfaction and patient decisions regarding healthcare use. Transportation accessibility, location convenience, and the availability of supporting facilities are factors that influence healthcare utilization ecasting (Gusparini 2021).

III. RESEARCH METHOD

A. Study Design and Setting

This study employed a quantitative observational-analytic design with a cross-sectional approach to examine the association between peak-hour road accessibility and healthcare utilization among patients attending the Primary Clinic of Poltekkes Kemenkes Semarang. The study was conducted in 2026 at the clinic located on Tirto Agung Street, Tembalang District, Semarang City, Indonesia.

The surrounding road network, particularly Tirta Agung Street and Prof. Soedarto Street, represents a highly active urban corridor characterized by educational, residential, commercial, and public-service activities. The cross-sectional design was selected because the study focused on assessing road-accessibility conditions and healthcare utilization patterns within the same observation period rather than evaluating longitudinal changes. Road-accessibility information obtained from respondents was complemented by direct transportation observations to provide contextual evidence regarding prevailing traffic conditions during peak travel periods.

B. Study Population and Sampling

The study population comprised individuals utilizing healthcare services at the Primary Clinic of Poltekkes Kemenkes Semarang. Participants were recruited using accidental sampling, in which eligible patients encountered during the study period were invited to participate. A total of 55 respondents who satisfied the predefined eligibility criteria were included in the analysis. Participants were eligible when they were non-emergency patients who traveled to and arrived at the clinic during the designated morning or afternoon peak-hour periods. Patients requiring immediate emergency intervention without undergoing routine healthcare visit procedures were excluded. Patients arriving outside the predefined traffic-observation periods were also excluded.

C. Study Variables and Operational Measurement

The study investigated two principal variables: road accessibility and healthcare utilization. Road accessibility was operationalized using respondents' reported travel time during peak traffic conditions. Because the measurement represented an ordered perception of travel duration, the variable was treated as ordinal and classified into three categories: short, moderate, and long travel time. Healthcare utilization was operationalized according to the respondents' routine frequency of using services at the clinic. This variable was also measured on an ordinal scale and classified into three categories representing different levels of service utilization: frequent, occasional, and never. Primary respondent data were collected using a closed-ended questionnaire. The questionnaire captured the perceived travel-time category and the frequency of healthcare utilization. These data were complemented by direct field observations of traffic conditions surrounding the clinic.

D. Peak-Hour Traffic Observation

Direct transportation observations were conducted along Prof. Soedarto Street and Tirta Agung Street, which constitute the principal access corridors to the clinic. Observations were undertaken during two predefined peak periods: 07:00–08:00 WIB in the morning and 16:00–17:00 WIB in the afternoon. The observations focused on three transportation characteristics: traffic flow volume, side friction, and changes in travel time. Side-friction observations included roadside activities capable of reducing effective road capacity, particularly on-street parking and

commercial activities. Traffic observations served as supporting engineering evidence for interpreting the accessibility conditions reported by respondents rather than as an independent exposure variable in the primary statistical model. This complementary approach enabled the study to integrate patient-level accessibility perceptions with actual traffic characteristics around the clinic during periods of high travel demand.

E. Data Processing and Statistical Analysis

The collected data underwent editing, coding, data entry, and tabulation prior to statistical analysis. Univariate analysis was performed to summarize the distribution of study variables and respondent responses using frequencies and percentages. Because both road accessibility and healthcare utilization were measured as ordinal variables, their association was examined using the Spearman rank-order correlation coefficient (ρ). Statistical significance was evaluated using an alpha level of 0.05. Accordingly, a p-value below 0.05 was interpreted as evidence of a statistically significant association between peak-hour travel time and healthcare utilization, whereas a p-value greater than or equal to 0.05 indicated insufficient evidence of a statistically significant association. The transportation-observation data were subsequently interpreted alongside the questionnaire results to provide an engineering context for the statistical findings, particularly in relation to traffic flow, side friction, travel delays, and accessibility conditions surrounding the clinic.

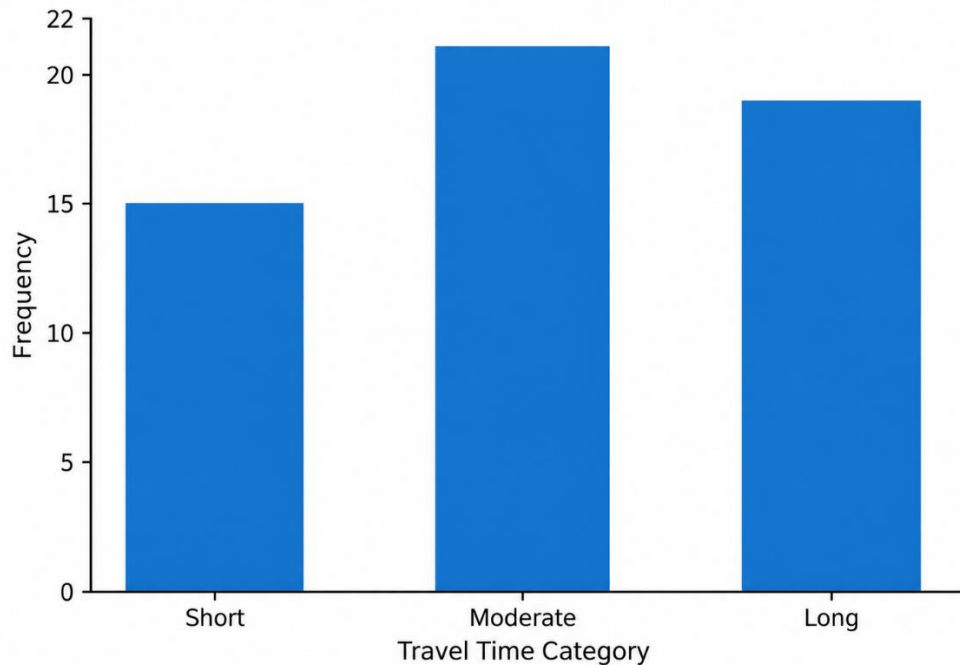


Figure 1. Distribution of Peak-Hour Travel Time among Respondents

IV. RESULT

A. Distribution of Peak-Hour Travel Time

The distribution of respondents according to peak-hour travel time is presented in Figure 1. Of the 55 respondents, 21 respondents (38.2%) reported a moderate travel time, representing the largest proportion of the sample. This was followed by 19 respondents (34.5%) who experienced a long travel time and 15 respondents (27.3%) who reported a short travel time. These findings indicate that more than two-thirds of respondents experienced either moderate or long travel times when accessing the clinic during peak traffic periods. The distribution suggests that travel to the clinic was generally subject to measurable accessibility constraints during morning and afternoon peak hours. For consistency with the operational definition of travel duration, the categories in Figure 1 should be presented as Short, Moderate, and Long rather than Fast, Moderate, and Slow.

B. Distribution of Healthcare Utilization

The frequency distribution of healthcare utilization showed variation in the respondents' routine use of services at the Primary Clinic. Among the 55 respondents, 22 respondents (40.0%) were classified in the never utilization category, representing the largest group. Meanwhile, 17 respondents (30.9%) reported frequent utilization, while 16 respondents (29.1%) were categorized as occasional users. The results therefore show that regular healthcare utilization was not dominant among the surveyed respondents. Although approximately one-third of participants reported frequent use of the clinic, a slightly larger proportion indicated that they did not routinely utilize the available healthcare services. This Result show in Table 1.

Table 1. regular healthcare utilization

Healthcare utilization category	Frequency (n)	Percentage (%)
Frequent	17	30.9
Occasional	16	29.1
Never	22	40.0
Total	55	100.0

One important correction is required in the current manuscript. The visual displayed under Figure 2 appears to reproduce the travel-time distribution, even though the caption refers to healthcare utilization. Therefore, Figure 2 should be replaced with a graph based on the actual utilization frequencies: Frequent = 17, Occasional = 16, and Never = 22.

C. Peak-Hour Traffic Conditions around the Clinic

Field observations conducted along Prof. Soedarto Street and Tirto Agung Street identified several transportation-related constraints affecting access to the clinic. The principal physical constraint was high side friction, particularly from on-street parking and commercial activities located along the road corridor. These activities reduced the effective road width and interfered with traffic movement during periods of high demand. During the morning peak period of 07:00–08:00 WIB and the afternoon peak period of 16:00–17:00 WIB, traffic flow at the nearest intersection reached up to 1,837 pcu/hour. Under these conditions, the manuscript reports a

decline in road operational performance and increased traffic delay. The observed bottlenecks were associated with an estimated 30–40% increase in patient travel time compared with free-flow conditions. The observational findings therefore provide supporting transportation evidence that peak-hour road conditions around the clinic were characterized by congestion, reduced effective capacity, and longer travel duration.

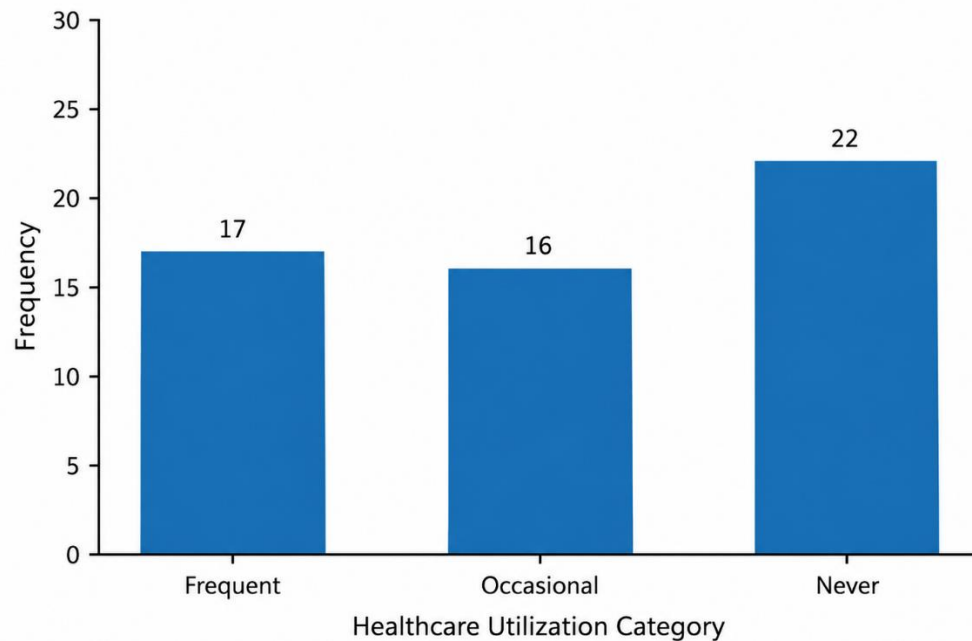


Figure 2. Distribution of Healthcare Utilization among Respondents

D. Association between Travel Time and Healthcare Utilization

The association between peak-hour travel time and healthcare utilization was examined using the Spearman rank correlation test. Based on data from 55 respondents, the analysis produced a correlation coefficient of $\rho = 0.125$ and a p-value of 0.361. Because the obtained p-value exceeded the predetermined significance level of 0.05, there was no statistically significant association between peak-hour travel time and healthcare utilization in the study sample. The magnitude of the correlation coefficient also indicated only a very weak positive association between the two variables. This result show in Table 2.

Table 2. Spearman rank correlation test

Variables	N	Spearman's ρ	p-value	Statistical interpretation
Peak-hour travel time $\times$ Healthcare utilization	55	0.125	0.361	Not statistically significant

E. Accessibility-Related Arrival Delays and Supporting Facilities

Although the statistical association between travel time and healthcare utilization was not significant, the combined questionnaire and field-observation data identified several accessibility-related effects on the respondents' travel experience. The manuscript reports that traffic

congestion in the Tembalang educational area contributed to approximately 50% of the recorded patient arrival delays during peak operational periods. In addition, parking availability received the lowest satisfaction assessment among the supporting-facility indicators. Limited parking capacity and traffic bottlenecks were concentrated particularly within approximately 200 m of the clinic, where road narrowing, roadside parking, and increased vehicle activity reduced traffic speed and prolonged the final stage of the journey to the clinic.

V. DISCUSSION

The findings indicate that peak-hour road accessibility did not show a statistically significant association with healthcare utilization at the Primary Clinic of Poltekkes Kemenkes Semarang, as reflected by the weak Spearman correlation coefficient ($\rho = 0.125$) and a p-value of 0.361. Although this result suggests that travel time alone was not a dominant determinant of whether respondents utilized the clinic, it should not be interpreted as evidence that transportation conditions were irrelevant to healthcare access. The field observations showed substantial peak-hour traffic pressure, side friction, and an estimated 30–40% increase in patient travel time relative to free-flow conditions.

This distinction between healthcare utilization decisions and accessibility experience is important. Previous studies included in the manuscript have shown that transportation barriers may contribute to delayed visits, missed appointments, and difficulties in reaching healthcare facilities, even when they do not completely prevent individuals from seeking care. Cochran et al. (2022), for example, identified transportation barriers as an important constraint among healthcare users, while Kabayundo et al. (2025) emphasized that transportation-related limitations can influence healthcare access through travel burden and related outcomes. The present findings are therefore compatible with the broader view that transport conditions may influence the quality and convenience of access without necessarily acting as the primary determinant of service utilization.

The weak statistical relationship may also reflect the multidimensional nature of healthcare utilization. The decision to use a healthcare facility is generally influenced not only by travel time, but also by service needs, perceived quality, cost, prior experience, and the availability of alternative facilities. The manuscript itself notes that healthcare utilization is shaped by multiple factors beyond accessibility alone. Therefore, the limited strength of the association observed in this study may indicate that respondents continued to utilize the clinic despite traffic-related inconvenience because other considerations remained more important in their decision-making process.

From a transportation perspective, however, the observed accessibility constraints were substantial. Traffic flow at the nearest intersection reached 1,837 pcu/hour, while on-street parking and commercial activities reduced the effective road width and contributed to congestion.

This condition is consistent with earlier studies cited in the manuscript showing that higher traffic volumes during morning and afternoon peak periods increase delays and reduce road performance in urban areas. The findings of Suharyo et al. (2021) concerning traffic volume at the Durian Raya–Tirto Agung intersection and Praharseno (2023) regarding increased traffic density during peak periods in the Banyumanik area provide a relevant local context for understanding the observed congestion pattern.

The results also highlight the role of side friction and parking availability as practical components of healthcare accessibility. The manuscript reports that parking space availability received the lowest satisfaction assessment and that traffic congestion contributed to approximately 50% of recorded patient arrival delays during peak operational hours. This observation is consistent with transportation studies in educational and mixed-use urban areas, where parking activity and high vehicle movements can reduce travel comfort and increase local congestion. Nur et al. (2023), for instance, discussed parking-related issues in university environments, while Sahri et al. (2021) emphasized the importance of traffic management in improving movement efficiency within dense urban activity zones.

Another important finding concerns the spatial concentration of the accessibility barrier. The study identified the most significant bottleneck within approximately 200 m of the clinic, where road narrowing, roadside parking, and increased vehicle activity caused vehicle deceleration and prolonged access to the facility. This suggests that healthcare accessibility in this context is not determined solely by total travel distance or overall travel time, but also by localized traffic conditions near the destination. This interpretation is consistent with Hadi et al. (2025), who emphasized that road-network quality and ease of transport access affect the effectiveness of reaching healthcare facilities.

The findings of this study therefore suggest that the relationship between transport accessibility and healthcare utilization should be viewed in two layers. At the behavioral level, peak-hour travel time was not significantly associated with whether respondents utilized the clinic. At the operational level, however, congestion, parking limitations, and side friction clearly reduced travel efficiency and punctuality. Purwito et al. (2025) similarly reported that travel time, waiting time, and service-related burdens can function as barriers to accessing primary healthcare, indicating that access constraints may still affect the patient experience even when utilization continues.

From a practical perspective, these findings support the need for integrated management between healthcare-facility access and surrounding transportation conditions. Improvements in roadside parking control, dedicated patient parking, directional signage, and local traffic management could reduce the final-access burden experienced by patients. Such measures would not necessarily increase healthcare utilization directly, but they could improve travel efficiency,

punctuality, comfort, and the overall accessibility of the clinic. The study therefore contributes to the understanding that urban healthcare accessibility should not be evaluated solely through utilization frequency, but also through the transportation conditions that shape the patient journey.

VI. CONCLUSION AND RECOMMENDATION

This study examined the association between peak-hour road accessibility and healthcare utilization at the Primary Clinic of Poltekkes Kemenkes Semarang. The findings showed that peak-hour travel time was not significantly associated with healthcare utilization among the 55 respondents ($\rho = 0.125$; $p = 0.361$). This indicates that travel time alone was not a dominant determinant of healthcare utilization in the study population. However, the transportation observations revealed substantial accessibility constraints around the clinic. Peak traffic flow reached 1,837 pcu/hour, while on-street parking, commercial activities, and reduced effective road width contributed to an estimated 30–40% increase in travel time compared with free-flow conditions. In addition, congestion was associated with approximately 50% of recorded patient arrival delays, and parking availability emerged as an important supporting-facility concern. Overall, the findings suggest that although peak-hour road accessibility did not directly determine healthcare utilization, it still influenced travel efficiency, punctuality, comfort, and the broader patient access experience. Improving local traffic management, parking arrangements, and directional access to the clinic may therefore enhance the quality of healthcare accessibility in dense urban environments.

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