# Understanding Pedestrians' Attitudes and Perceptions Towards Road Safety: A Case Study of Jakarta, Indonesia

Vania ASBAHANY [a], Shahana AVATHKATTIL [b], Sahan BENNETT[c], Priyantha WEDAGAMA [d], Dilum DISSANAYAKE [e]

[a] *Greater Jakarta Transport Authority, Ministry of Transportation, Jakarta, 10110, Indonesia*
[b] *School of Engineering, Newcastle University, Newcastle Upon Tyne, NE1 7RU, United Kingdom*
[c] *College of Medicine, Glasgow University, Wolfson Medical School Building, Glasgow, G12 8QQ, The United Kingdom*
[d] *Department of Civil Engineering, Udayana University, Bali, 80361, Indonesia*
[e] *School of Geography, Earth and Environmental Sciences, University of Birmingham, B15 2TT, United Kingdom*

[a] *E-mail: vania_asbahany@kemenhub.go.id*
[b] *E-mail: Shahana.Avathkattil@newcastle.ac.uk*
[c] *E-mail: sahan.bennett3@nhs.scot*
[d] *E-mail: priyantha@civil.unud.ac.id*
[e] *E-mail:d.dissanayake@bham.ac.uk*

**Abstract**: Pedestrians are vulnerable road users, and their safety remains a critical issue in developing economies such as Indonesia, where pedestrian fatalities constitute 15.5 % of road traffic deaths. This study investigates pedestrians' attitudes and perceptions towards road safety in Jakarta using questionnaires, both online and in person. Descriptive statistics and Categorical Principal Component Analysis were applied to uncover key components influencing these perceptions. Results indicate that poor infrastructure, including inadequate footpaths and pedestrian crossings, bad road surfaces, coupled with illegal on-street parking, significantly contributes to traffic accidents. Additionally, driver behaviours such as carelessness, cell phone use, and aggressive driving exacerbate risks. The findings reveal limited pedestrian awareness of traffic rules but strong support for safety measures, including enforcing speed limits, banning street vendors on footpaths, and prohibiting on-street parking. This study highlights the urgent need for improved infrastructure and targeted safety interventions to enhance pedestrian safety in Jakarta.

*Keywords*: road safety, questionnaire survey, perceptions, pedestrians, Categorical Principal Component Analysis

## 1. INTRODUCTION

Active mobility plays a pivotal role in the transition toward sustainable transportation, particularly in achieving decarbonization goals. Walking, as the most fundamental form of active mobility, not only reduces greenhouse gas emissions but also promotes a healthier urban environment and lifestyle. However, ensuring the safety of pedestrians remains a significant challenge in the design and operation of transportation systems. Understanding pedestrians' attitudes and perceptions toward road safety is essential to addressing this issue effectively.

The World Health Organization (WHO) has identified pedestrians as vulnerable road

users, noting that a significant proportion of global road traffic deaths occur among this group (World Report on Road Traffic Injury Prevention, 2004). WHO (2018) estimates roughly 88% of pedestrians in the world walk in an unsafe environment that increases the possibility of involvement in road traffic collisions. Pedestrian fatalities accounted for 15.5% of road traffic deaths in Indonesia (Global Health Observatory data, 2016). In developing economies like Indonesia, notably in Jakarta, efforts have been made to encourage walking. Jakarta has made improvements to footpaths and increased the total pedestrian pathway length to 543,073.65 meters in 2016, up from a stagnant 540,336.86 meters over the previous nine years (BPS-Statistics of DKI Jakarta Province, 2018). Additionally, the launch of the Mass Rapid Transit (MRT) system in Jakarta has attracted an average of 93,215 passengers per day by July 2019. With the expected rise in pedestrian activity in areas supplied by MRT, the government must prioritize pedestrian safety by implementing measures that address the increased foot traffic and enhance road safety infrastructure.

WHO (2004) identified a paradigm shift among traffic safety professionals who now understand road safety as a multi-sectoral issue and a public health issue that is preventable and predictable. It is believed that traffic injury prevention related to the public health issue could be approached from the behavioural aspect of road users. Similarly, The United Nations (Decade of Action for Road Safety, 2011-2020) realized that road safety issues have gained international awareness over the last decade and have raised the momentum to recognize road safety as a global policy issue. Regarding the behavioural aspect of road safety, location specific improvement in road design as well as in policy may be implemented.

Extensive research has been conducted on road user behavior in traffic, but studies specifically focusing on attitudes toward road safety remain limited (Papadimitriou *et al.*, 2012; Musselwhite *et al*., 2009; Ram and Chand, 2016). Notably, Papadimitriou *et al*. (2012) identified significant variations in behavior and perceptions of road safety across European countries, highlighting the influence of location on population behavior. Previous studies (Papadimitriou *et al.,* 2012; Musselwhite *et al.,* 2010; Choi *et al.,* 2019) show that understanding road user behaviour can assist planners to improve safety by means of improving design or change in policies. Moreover, targeted and location-specific campaigns addressing behavior and associated risks have been shown to effectively raise road safety awareness (Shiwakoti *et al*., 2018). Despite the growing concerns regarding pedestrian safety in Jakarta and the increasing levels of pedestrian activity, no research to date has explored pedestrians' attitudes and perceptions toward road safety in this context.

Addressing this gap forms the primary motivation for this study. Objectives of this research include:

1. To identify key pedestrian safety issues through a comprehensive literature review and form a well-structured questionnaire to gather data on pedestrians' attitudes and perceptions towards road safety in Jakarta.
2. To perform detailed descriptive and factor analysis to explore underlying patterns and insights into pedestrian attitudes and perceptions related to road safety.
3. To highlight priority issues for future policies that can effectively enhance pedestrian safety in Jakarta.

## 2. LITERATURE REVIEW

Walking is an essential and universal mode of transportation. The term pedestrian applies to most individuals capable of walking as their primary method for commuting. In Japan, increased walking time has been linked to reduced medical costs due to a healthier lifestyle (Tsuji *et al*., 2003). Recent research has found that benefits from walking could overcome health

consequences from pollution (Tainio *et al*., 2016; Mueller *et al*., 2015) and outweighed the detrimental effects of traffic incidents (Mueller *et al*., 2015). However, the danger of injuries resulting from interactions with motorized traffic remains a significant concern that cannot be overlooked. The powerlessness to protect oneself from a heavier vehicle in a traffic collision makes a pedestrian a vulnerable road user (DaCoTa, 2012). WHO (2013) points out that pedestrian injuries and fatalities are in fact predictable and preventable, albeit many countries still disregard pedestrian safety aspects in road planning.

### 2.1 Pedestrian Road Safety Issues in Jakarta

Inadequate consideration of pedestrian safety in Indonesia is very clear, especially in Jakarta where only 543 km sidewalk has been built amongst a total length reaching 6,492 km of non-toll roads (BPS Statistics of DKI Jakarta Province, 2018). The lack of pedestrian paths could be one of the many factors that cause the high proportion of pedestrian involvement in collisions, since the intensity of the interaction between pedestrian and motorized vehicle is higher when there is no separation between the two road users. In addition to the shortage of sidewalks, a proportion of existing sidewalks in Jakarta are in such poor condition that it drives pedestrians to walk on main roads and share their right of way with motorized vehicles (Deny, 2019). Jakarta additionally faces safety challenges due to the misuse of sidewalks, often occupied by street vendors. While the government permits vending in approved locations, many vendors violate regulations, disrupting pedestrian movement (Metrotvnews, 2019). Regrettably, in addition to street vendors who abuse the use of footpaths in Jakarta, motorcycles and cars use them as a parking area (Nugroho, 2019).

during January-March 2019, 158 Indonesian pedestrians were involved in road collisions, likely due to insufficient crossing facilities. Unfortunately, there has been no specific information about the type and the quantity of crossing facilities that are available across the country. Also, there are not many signalized crossings in Jakarta and most of them are under-utilized (Putri, 2018; CNN Indonesia, 2018; Ramadhan, 2018). Pedestrian bridges are used to ensure safe road crossings without disrupting traffic, but in Indonesia, they are primarily found on wider roads, leaving smaller roads without crossing facilities. Many pedestrians perceive bridges requiring long detours as inconvenient, prompting risky behavior such as jaywalking to save time (Xu *et al.,* 2018, Althoff *et al.,* 2017). Additionally, over 50% of pedestrian bridges in Jakarta are reportedly in poor condition, posing risks such as structural safety concerns or vulnerability to criminal activities (Yusuf, 2019). This discourages use, even where bridges are available, and increases the likelihood of pedestrian crashes, as drivers are less alert to jaywalkers near such facilities. The combination of inadequate infrastructure, poor bridge maintenance, and behavioral tendencies highlights the urgent need for safer and more accessible pedestrian crossing solutions.

### 2.2 Methodology to investigate road users' behaviour

Field observations, interviews and/or questionnaires can be used to analyse road users' behaviour, *Table 1* summarises the methodology used in previous studies to investigate road users' behaviour. From the table, interviews and questionnaires are known to be the most common method used in previous studies. Bonnel (2009) explains that in-depth interviews and focus groups can play important roles to provide insight into pedestrians' motivations and attitudes. Bonnel (2009) also believes that opinions and attitudes can be observed using questionnaires, with the most common type being multiple-choice questions and Likert scale questions. While data on behaviours can be potentially susceptible to social desirability, self-

completion questionnaires with anonymous answers can be a mitigation measure by eliminating the involvement of an interviewer. With the absence of the interviewer, opinions of the respondent will not be disturbed and the cost to conduct the survey is cheaper (Richardson *et al*., 1995). However, the layout and wording of the questions must be clear and simple so that no misinterpretation issues will arise.

Table 1. Methodology used to investigate road users' behaviour in previous studies

| Author (s) | Year | | Field observation | Interview/ Questionnaire |
|---|---|---|---|---|
| Papadimitriou *et al*. | 2016 | Pedestrians' crossing behaviour | ✓ | ✓ |
| Xu *et al.* | 2018 | Relationships between pedestrian inconvenience and behaviour | | ✓ |
| Choi *et al.* | 2019 | Older pedestrians' crossing behaviour | ✓ | ✓ |
| Oxley *et al.* | 1997 | Traffic judgements of young and old adult pedestrians | ✓ | |
| Ni *et al.* | 2017 | Pedestrians' safety perception at signalized intersection | | ✓ |
| Rehman *et al.* | 2015 | Taxi drivers' attitudes towards road safety | | ✓ |
| Ram and Chand | 2016 | Relationship among road safety attitude, risk perception, and perception of driving | | ✓ |
| Chu *et al.* | 2019 | The effects of Traffic Climate Scale factors on drivers' behaviours | | ✓ |
| Taubman-Ben-Ari and Shay | 2012 | Associations between risky behaviours of drivers and pedestrians | | ✓ |
| Thibenda *et al.* | 2022 | Driver perception on road safety | | ✓ |

Several analytical methods have been used to examine road users' behaviour. Descriptive analysis is the most straightforward methodology, where distribution of responses is presented. Variables that are investigated in social and behavioural sciences are generally non-parametric variables, hence frequencies of each variable are common measurements examined particularly in the study of road users' behaviour (Papadimitriou *et al*., 2017; Wu *et al*., 2019; Chu *et al*., 2019). In addition, there is various research in road users' behaviour that use factor analysis or principal component analysis (PCA) (Papadimitriou *et al*., 2013; Papadimitriou *et al*., 2017; Cordellieri *et al*., 2019; Chu *et al*., 2019). Abdi and Williams (2010) claims that PCA is the most popular technique used by almost all scientific disciplines. PCA aims to reduce the data set size to a more manageable size by grouping variables but keeping the most important characteristics of the data. Like PCA, factor analysis also aims to reduce a set of variables into a smaller set of dimensions; however, they are two different analysis techniques (Field, 2018). Factor analysis explains the maximum amount of common variance in a correlation matrix, while PCA explains the maximum amount of total variance in a correlation matrix by transforming the original variables into linear components (Field, 2018). In this study detailed descriptive analysis and factor analysis is carried out to identify the underlying factors of pedestrians' attitudes and perceptions in Jakarta.

## 3. METHODOLOGY

### 3.1 Data Collection

The aim of this project is to study the perception of pedestrians in Jakarta. WHO (2013) describes a pedestrian as 'any person who is travelling by walking for at least part of his or her

journey'. The questions were constructed based on the questionnaire made for the latest research on road users' perception in Europe, the SARTRE Project. The report states that pedestrians are 'respondents who reported that their most frequent transport mode in the last 12 months was neither passenger car nor motorcycle and who reported non-zero daily walking distance travelled'. Similarly, respondents that qualified for this study are those who did not choose driving a car or riding a motorcycle as their most frequent mode of transport. Since the questionnaire for the SARTRE Project was designed to recommend road safety measures for countries in Europe, adjustments were made to the questions to fit the issues of road safety in Jakarta. Pedestrians who reported using car or motorcycle as passenger, for example using taxis, were allowed to take part in this research. Since, English is not the first language of people in Jakarta, the questionnaire was made in Indonesian language. Furthermore, since the working age limit was 15 years in Indonesia, the age group under 15 were assumed not old enough to travel alone and not capable enough to participate in the survey.

The total number of questions asked for this research is 28, consisting of multiple-choice questions, Likert scale statements and an open-ended question, which are grouped into six sections. The sections accommodate socio-demographic, travel pattern, motivations for walking or using public transportation, opinions on road safety performance, opinions on traffic accidents and opinions on road safety measures. The survey was carried out both online-based and paper-based mode. Before the actual survey was administered to pedestrians in Jakarta, a pilot survey was conducted which tested the question wording, layout of the questions, online data entry and the adequacy of the survey in general.

The sample size required for the survey was estimated by the method proposed by Ortúzar and Willumsen (2011). A total of 387 online-based and 48 paper-based responses were collected from the survey. With a total of 435 complete responses, the minimum requirement of the sample size (#400) was met. Therefore, it is safe to say that the sample represents the population of pedestrians in Jakarta with 5% of errors being considered in the result.

### 3.2 Methodology for Data Analysis

Descriptive analysis was carried out in SPSS software to investigate the socio-demographic aspect of the respondents. Detailed statistical analysis was carried out ***principal component analysis (PCA),*** and ***categorical principal components analysis (CATPCA)*** to identify the underlying components of pedestrians' attitudes and perceptions in Jakarta. Grouping items was achieved using principal component analysis (PCA). Linting and van der Kooij, (2012) suggested that non-linear principal component analysis (NLPCA) is the most suited technique to analyze a set of data containing variables with different measurement levels (nominal, ordinal, or numeric) that may be non-linearly correlated to each other. NLPCA was utilized accordingly in this study to investigate the factors of pedestrians' attitudes and perception on road safety. To analyse data using this method, CATPCA command in SPSS is used.

Despite being the most appropriate method of component extraction for this study, the number of components in CATPCA should be determined beforehand. To discover the number of components in pedestrians' attitudes and perception towards road safety, traditional methods of identifying cluster of variables were applied. PCA was used in this study. The results were compared to get the most optimised result. The dimension reduction process is presented in Figure 1.

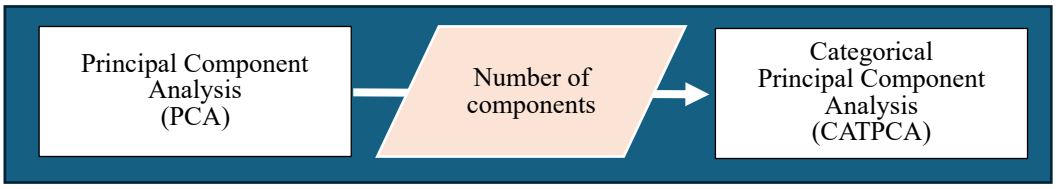



Figure 1. Flowchart of dimension reduction process using

## 4. ANALYSIS AND RESULTS

### 4.1 Descriptive Analysis

#### 4.1.1 Socio-demographic data

From a total of 435 respondents, 243 were male and 192 were female. Most respondents were in the younger group, that is aged 15 to 29, with 287 people involved. Most of the participants have reached a higher level of education and work in an office. Research by Goldenbeld & de Craen (2013) suspect that online questionnaires tend to attract respondents from more privileged social groups (higher income or higher education). Even though the proportion of these respondents is exceptionally high, this occurrence is less likely to be due to the survey methods given that Jakarta is the center of economic activities in Indonesia. 63% of the pedestrians in Jakarta hold a driving license. In addition, almost 77% of the respondents reported owning at least one motorized vehicle at home. This indicates the high rate of motorization in Jakarta.

*Table 2. Participant demographics (N=435)*

| | n | Percentage | | n | Percentage |
|---|---|---|---|---|---|
| **Gender** | | | **Driving licence** | | |
| Male | 243 | 56% | Yes | 274 | 63% |
| Female | 192 | 44% | No | 161 | 37% |
| **Age** | | | **Occupation** | | |
| 15-19 | 45 | 10% | Student | 78 | 18% |
| 20-29 | 242 | 56% | Office worker | 276 | 63% |
| 30-39 | 93 | 21% | Self employed | 37 | 9% |
| 40-49 | 39 | 9% | Not employed | 10 | 2% |
| 50-59 | 14 | 3% | Retired | 1 | 0% |
| >60 | 2 | 0% | Other | 33 | 8% |
| **Level of Education** | | | **Household vehicle ownership** | | |
| Did not go to school | 1 | 0% | No vehicle | 102 | 23% |
| Primary school | 0 | 0% | Motorcycle(s) | 143 | 33% |
| Secondary school | 13 | 3% | Car(s) | 80 | 18% |
| High school | 97 | 22% | Motorcycle(s) & car(s) | 110 | 25% |
| Higher education | 324 | 74% | | | |

#### 4.1.2 Travel pattern

It is interesting to note that the number of pedestrians in Jakarta who reside outside of the boundary reached 34%. From 34% of them, a large share (i.e., 84%) regularly commute to and from Jakarta, presumably to work or study, and only 16% of the non-residents travel less

frequently. As much as 86% of pedestrians in Jakarta reported that the purpose of their main trip was commuting to work or school (Figure 2). The most reported frequency of their travel was 'almost every day', with 83% of the total responses, since they mostly travel to work or school. Our survey shows that 63% of pedestrians depend on public transportation to travel around Jakarta. Additionally, 23% of pedestrians are passengers on motorcycles although this may include users of the infamous motorcycle taxis that can be found in every corner of Jakarta. Regretfully, the number of people that use bicycles as their main mode of transport in Jakarta was minimal.

Half of the respondents chose congestion followed by financial reasons as their motivation to walk or use public transport in Jakarta. Most of the public transportation in Jakarta has its own right of way that limits them from congestion. Consequently, any improvement that resulted in less travel time and cost for using public transport could increase pedestrian activities in Jakarta.

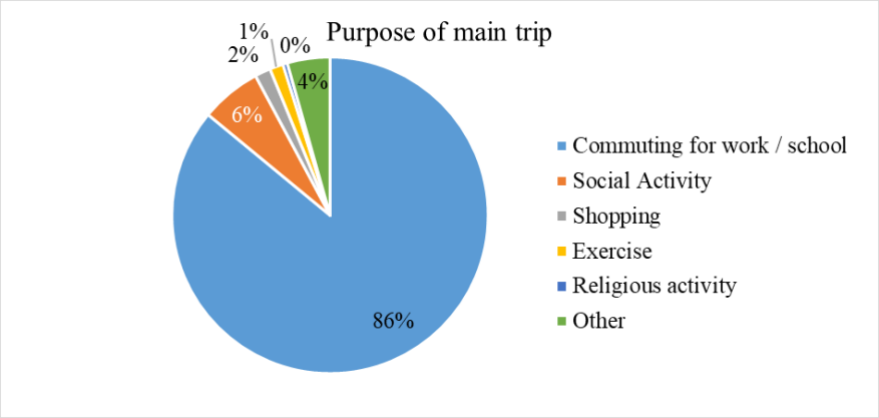



Figure 2. Purpose of pedestrians' main trip in Jakarta

### 4.1.3 Opinions on road safety performance

It was found that less than half of pedestrians in Jakarta ever received road safety education in school, indicating a deficiency in road safety knowledge. This study showed that most pedestrians in Jakarta were not satisfied with the level of road safety. Only 31% of pedestrians considered roads in Jakarta to be 'very safe' or 'safe' to travel on. The distribution of pedestrians' opinion on the level of concern the government gives to road safety is similar between 'fairly' (42%) and 'not much' (47%) with 'not much' being the more common response. Most pedestrians in Jakarta are 'not much' or 'not at all' satisfied with the overall level of service of the roads they walk on. Figure 3 shows that pedestrians in Jakarta seem to be happier with the number of streetlights and pavement conditions in Jakarta, where almost half of the pedestrians' answer 'very' or 'fairly'.

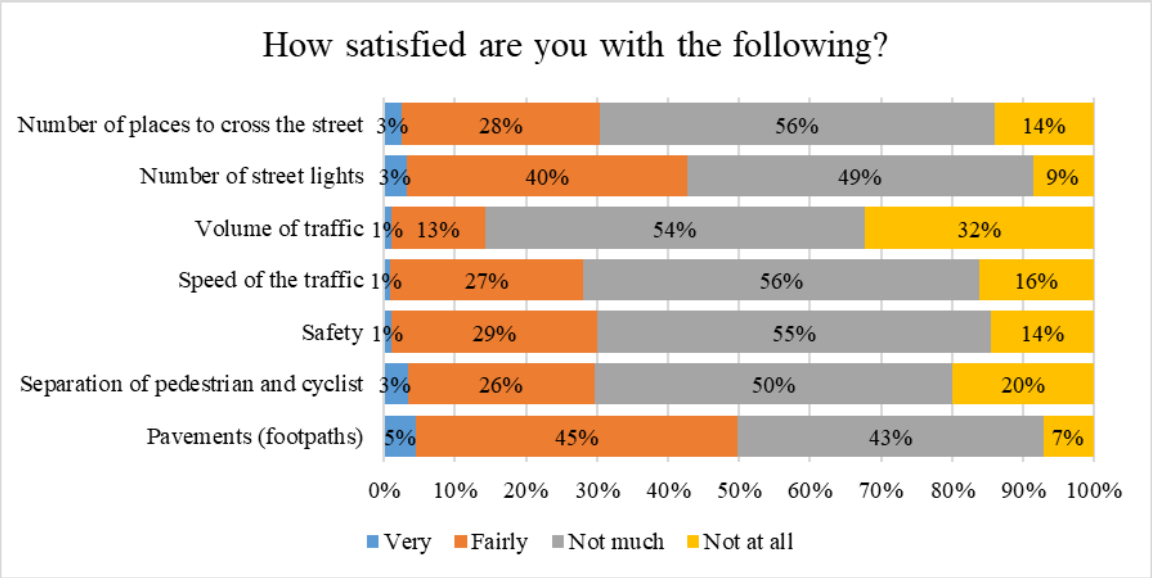
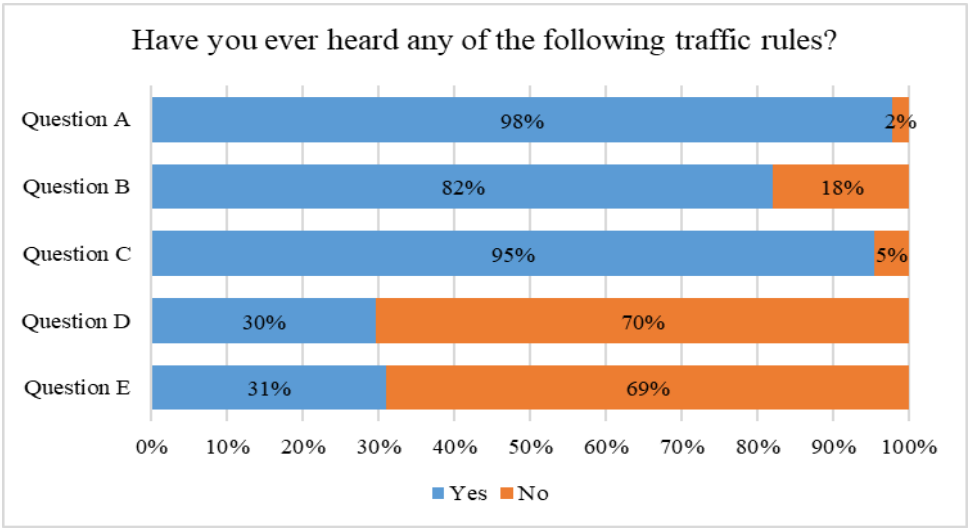



Figure 3. Pedestrians' perceived level of service

Pedestrians were asked the following questions (A to E) to understand their knowledge of traffic rules related to walking (Figure 4). The results revealed that pedestrians in Jakarta are aware of the traffic rules, except for the recommendations of using reflective clothing in low light conditions and keeping on the right-hand side of the road.

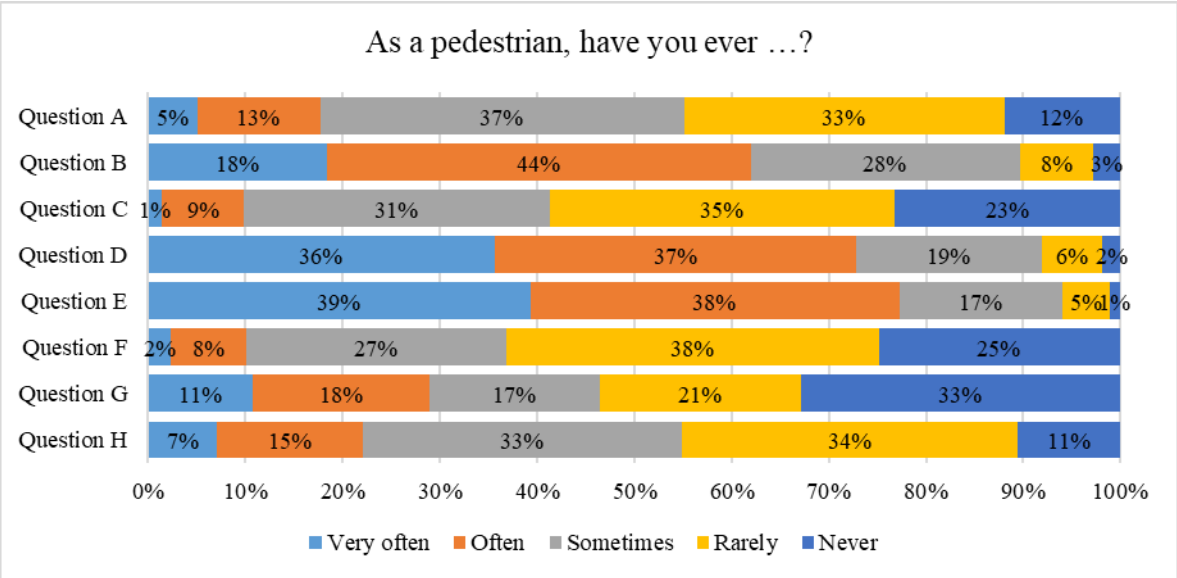



Question A Pedestrians have to cross in the designated place when available
Question B Pedestrians have the highest priority when crossing in the designated place
Question C Recommendation to look right-left-right before crossing
Question D Recommendation to wear light coloured/reflective clothing in rain or nighttime
Question E Recommendation to keep on the right side of the road to see oncoming traffic

Figure 4. Knowledge of traffic rules

Pedestrians were asked further questions (A to H) related to walking behaviour in Jakarta (Figure 5). The results showed that 45% of pedestrians in Jakarta reported to 'rarely' or 'never' cross the streets at places other than pedestrian crossing. It was also found that most pedestrians 'very often' or 'often' change their walking behaviour due to the condition of their

walking path, such as dangerous streets, parked vehicles and the presence of street vendors. At the same time, behaviours related to distracted walking such as (answering calls; use of music devices; focus on other things other than roads and the environment) are mostly reported as 'rarely' or 'never'. On the other hand, only 10% of pedestrians 'very often' or 'often' used reflective clothing.




Question A Cross streets not at the designated area when pedestrian crossings are available
Question B Avoid dangerous streets or intersection in relation to the risk of accident
Question C Wear light coloured or reflective clothing
Question D Walk on the carriageway when footpaths are blocked by parked vehicles
Question E Walk on the carriageway when footpaths are blocked by street vendors
Question F Make/answer a call with handheld phone
Question G Use MP3/iPod/other music devices
Question H Walk while having focus on things other than the roads or road environment

Figure 5. Pedestrian behaviour

### 4.1.4 Opinions on traffic accidents

Our survey shows that as many as 30% of pedestrians in Jakarta have been involved in a traffic accident as a pedestrian. Figure 6 shows that the vast majority (more than 80%) of pedestrians believe sharp curved roads without footpaths are the 'most likely' or 'likely' place to have traffic accidents. Other locations chosen by pedestrians in Jakarta as having high possibilities (more than 60% 'most likely' or 'likely' responses) of accidents are railway crossing points, crossing major or wide roads with dual carriage lanes, and intersections without traffic signals or traffic police. Footpaths with heavy traffic and crossing minor roads without any footpath are viewed as having moderate possibilities for accidents. The level of perceived danger near the entrance or exit of parking spaces is not apparent as most pedestrians (46%) chose the 'neutral' response. On the other hand, intersections with traffic signals or traffic police are thought to be the safest location out of the other scenarios with 44% pedestrians choosing 'unlikely' or 'most unlikely'.

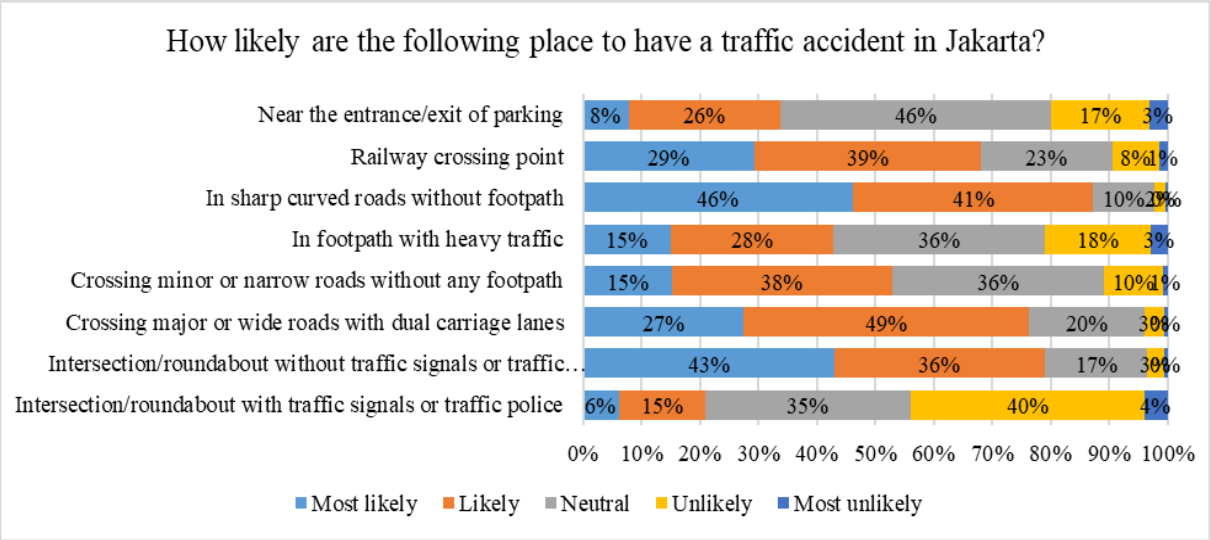



Figure 6. Perceived danger of possible incident locations

Motorcycles were selected as the leading cause of traffic accidents in Jakarta from pedestrians' point of view. This is aligned with the data collected by WHO (2018) which shows that over 70% of road fatalities in 2016 involve motorcyclists. Furthermore, Figure 7 shows that only a little over 50% of pedestrians 'strongly agree' or 'agree' to bad weather as being the major cause of traffic accidents, although most accidents (94.81%) in Indonesia happened in clear weather (National Criminal Information Centre, 2023). Most pedestrians 'strongly agree' or 'agree' to the cause of collisions due to the lack of infrastructure and risky driving behaviour. In addition, the respondents believed that the riskiest time for an accident to happen is in the evening (16:00 – 20:59) and followed closely by the morning hours (06:00 – 9:59). Both times are during the rush hour, thus indicating that a higher number of vehicles on the roads during this time is perceived as creating more danger to pedestrians.

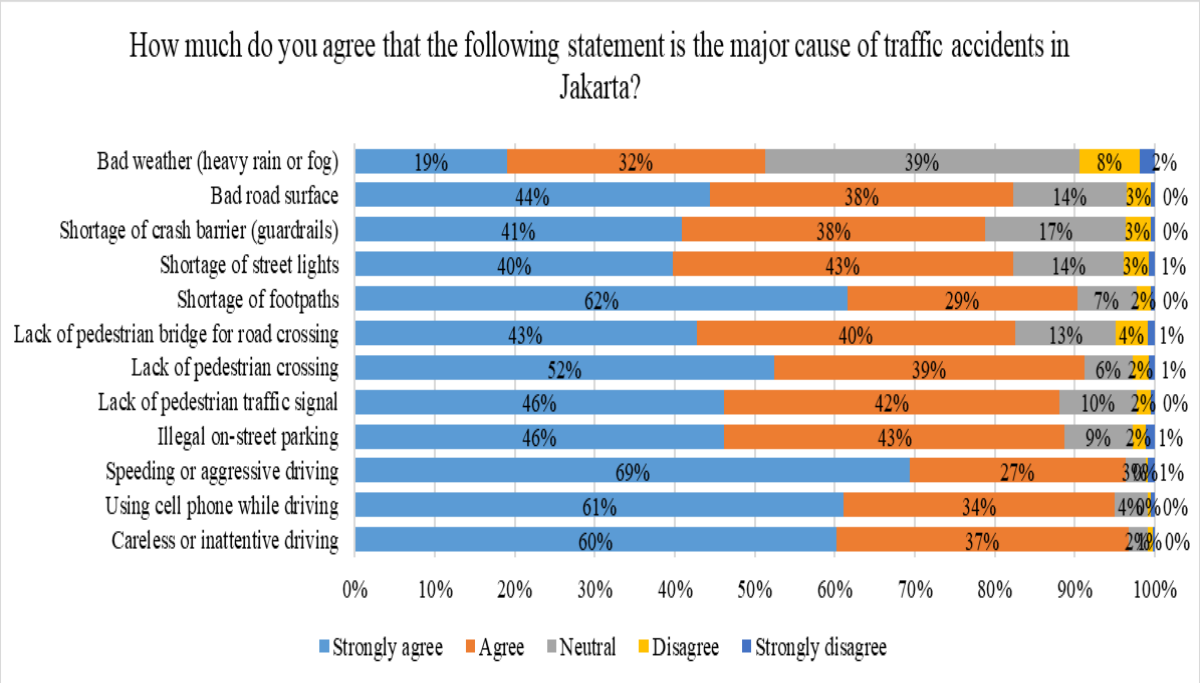



*Figure 7. Major cause of traffic collisions (condition)*

### 4.1.5 Opinions on road safety measures

Most pedestrians regard all statements following the questions about safety measures to be important (Figure 8). Moreover, improving road infrastructure was judged to be the most important measure as the response to 'very important' reached 85%. While dissemination of road safety education is part of road safety improvement, pedestrians think that the group that needs it the most is motorcyclists. The group that has the second highest vote is public transport drivers, especially the paratransit modes that do not have their own dedicated lane. It is found that education for school children, with the highest votes, is more preferable than providing it for adults. Umniyatun *et al.* (2021) found that a large part (61.1%) of high school students in the Jakarta Metropolitan Area had driven motorcycles as their means of transportation, albeit 91% of the riders did not have a driving license. Thus, school children are potentially the most effective target group for road safety education. It was interesting to discover that truck/trailer drivers received less votes than car drivers as the group in need of road safety education. This is possibly because the speed of trucks/trailers that travel in Jakarta is very slow. Additionally, cyclists receive the least attention as a group requiring road safety education.

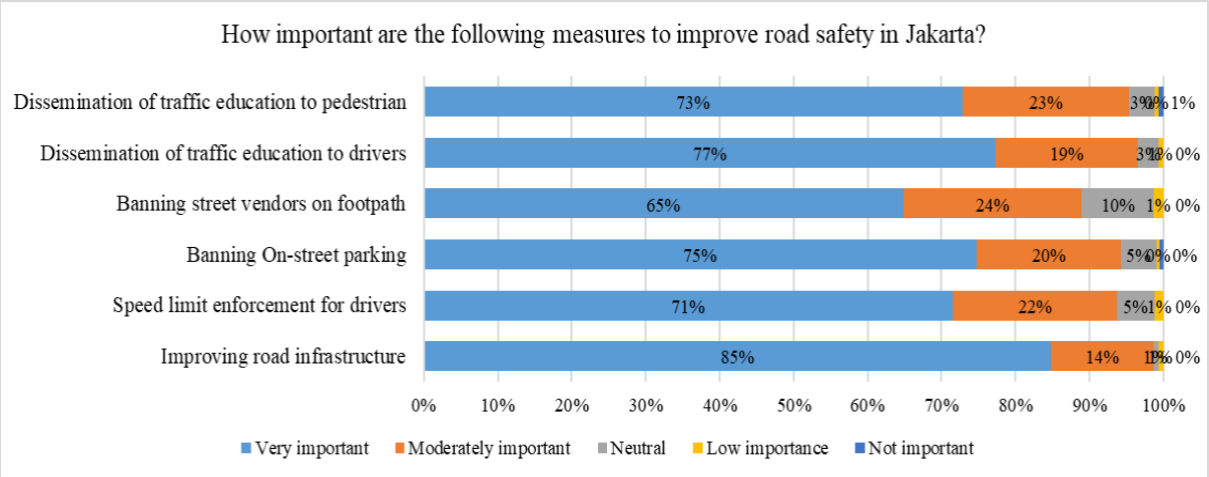



Figure 8. Importance of road safety measures

The next question asked was about the most effective method of conducting a safety campaign. Advertising on social media is the most effective platform for pedestrians. Furthermore, it seems that road safety campaigns in road intersections are not favourable to pedestrians. Another method that is suggested by pedestrians is to share the campaign via printed media, such as newspapers and magazines.

The last question is an open-ended question regarding commentary on road safety conditions in Jakarta. Large numbers of pedestrians in Jakarta are not satisfied with road safety conditions in Jakarta. The main issue that is mostly talked about in this question concerns the lack of road user awareness on road safety. Most pedestrians who complain about road user awareness on road safety, express their disappointment towards motorcyclists who often make them feel unsafe. Inadequate facilities and law enforcement are also of concern to pedestrians in Jakarta. Pedestrians think that improvements were made unevenly throughout the province. A small portion of the responses believe that the unsafe road environment in Jakarta is associated with traffic volume.

### 4.2 Main Analysis

The main analysis starts with the application of Principal Component Analysis (PCA) to attitudinal statements followed by Categorical Principal Component Analysis (CATPCA).

#### 4.2.1 Principal Component Analysis (PCA)

PCA was performed to determine the number of components to retain. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for these variables was 0.78, which falls into the "middling" category as defined by Kaiser (1974) and is therefore considered acceptable. Number of components to be extracted can be determined by retaining components with eigenvalues greater than 1; however, this criterion overestimates the result for a sample size larger than 200 (Field, 2018). The scree plot was then examined to locate the breaking point of the curve where a sudden change in the gradient occurred. This point of flattening out was selected as the number of components to be retained (Field, 2018; Costello & Osborne, 2005). Furthermore, Costello & Osborne (2005) suggest multiple analysis for a different number of components (below, at and above the indicated number) to be certain. The extraction with the smallest percentage of 'nonredundant residuals with absolute values greater than 0.05' was chosen as the most ideal number of components, as suggested by Field (2018).


Figure 9. Scree plot from PCA

The scree plot showed that the breaking point was at 4 components. PCA was subsequently performed at 3, 4 and 5 components to obtain optimum extraction. All analysis resulted in 3 or more variables for each component, which met the minimum condition for a component. The percentage of 'nonredundant residuals with absolute values greater than 0.05' for each extraction is provided in *Table 3*. The preferred number for extraction was 5, accordingly.

Table 3. Percentage of 'nonredundant residuals with absolute values greater than 0.05'

| Number of components extracted | Percentage of 'nonredundant residuals with absolute values greater than 0.05' |
|---|---|
| 3 | 33.5% |
| 4 | 30.5% |
| 5 | 30.3% |

The five components extracted had eigenvalues of larger than 1 and explained 27.77% of the total variance.

### 4.2.3 Categorical Principal Component Analysis (CATPCA)

To enhance the model of non-linear relationship between categorical data, CATPCA was applied with the proposed number of components from PCA. Scaling of each of the variables was set according to the type of variables (ordinal and nominal) specified previously. In addition, CATPCA identifies 0 as a missing value, making all 'no' answers as missing values. As these 'no' answers were essential, missing values in this analysis were treated as an extra category, where they were quantified to a separate category.

The variance of the 5 components from CATPCA accounted for 31.45% of the total variance, which evidently depicts an improved model. Variables and their loadings for each dimension are presented in *Table 4.* Variables that loaded highly were regarded as substantial variables that determine the focus of a component. Field (2018) recommended a value of above 0.40 (regardless of its positive or negative sign) for a loading to be considered as a high loading. However, Steven (2002) indicated that 0.26 was an acceptable value for a sample size of more than 400. In this study, 0.30 was chosen as the criterion for a significant loading value. Substantial loadings are highlighted in green. The components of pedestrian perception and behaviour towards road safety are explained as follow:

- ***Component 1: Think that infrastructure is the main cause of traffic accidents***
  This component mainly focused on the infrastructure aspect of safety, particularly in the cause of accidents and the road safety measures. This component is also associated with the dissatisfaction with infrastructure availability that is indicated with negative value for question D6f and D6g. Moreover, this component was also related to the level of agreement of road safety measures to improve the infrastructure. This matches with a previous study conducted in Penang, Malaysia (Fan, *et al*., 2024) which used space syntax indicators to assess pedestrian accessibility and safety. These indicators included overall network connectivity, poor access to major tourist attractions, suboptimal integration, pedestrian flow concentration, and significant safety concerns exacerbated by limited infrastructure and a lack of pedestrian crossings on certain two-lane roads. This study suggested to improve pedestrian areas along certain roads and strategically installing pedestrian crossings.
- ***Component 2: Safe walker and think that traffic safety education is important***
  Most of the variables included in this component are related to traffic safety education dissemination. This component correlates negatively with the likeliness of accident in a more controlled environment. In addition, this component suggests a safe walking behaviour regarding attention while walking.
- ***Dimension 3: Satisfied with safety performance and think pedestrians do not need safety education***
  This component brings together variables concerning satisfaction with road safety performance. However, this component correlates negatively with the opinion of pedestrians and public transport drivers should have traffic safety education.

- ***Component 4: Think that driver awareness is the factor in traffic accidents***
  This component combines the perceptions of pedestrians on the awareness of drivers that may lead to traffic accidents.
- ***Component 5: Not familiar with traffic rules but support safety measures***
  This component consists of variables supporting regulations to improve safety. However, this component associates with the lack of knowledge of traffic rules as a pedestrian.

The Cronbach's alpha of Components 1, 2, 3, 4 and 5 are 0.88, 0.83, 0.78, 0.73 and 0.66 respectively. Cronbach's alpha is a measure of reliability which evaluates the consistency of an item (Peterson, 1994; Field, 2018). Murphy & Davidsholder (1988) recommended a value of above 0.60 for an acceptable reliability value. Similarly, Hinton *et al*. (2004) classified a reliability value of 0.50 – 0.70 as a moderate reliability. At the same time, Kline (2000) suggested a minimum Cronbach's value of 0.70 for a reliable result. In accordance with the threshold, all components fell into the acceptable range of reliability. Component 1 to 4 were considered high in their reliability, while Component 5 was viewed to be moderately reliable.

In summary, this study explained the attitudes and perceptions of pedestrians towards road safety in Jakarta. It was revealed that there are five underlying factors of attitudes and perceptions towards road safety, namely: 1) Pedestrians think that poor infrastructure such as lack of footpaths, lack of pedestrian crossings, lack of guardrails, bad road surfaces, illegal on street parking, lack of pedestrian traffic signals are the main causes of traffic accidents. This is in line with a previous study (Hamim and Ukkusuri, 2024) conducted in Dhaka (Bangladesh) which also found that the presence of footpaths had the greatest impact on road safety perception scores, followed by other characteristics such as roads, population density and relative wealth index. 2) Pedestrians support safe walking behaviour and think that traffic safety education of vehicle drivers is important. 3) pedestrians are satisfied with safety performance (such as pavement condition and speed of traffic etc.) and think pedestrians do not need safety education. 4) Pedestrians think that lack of driver awareness such as carelessness, cell phone usage and aggressive driving are factors in traffic accidents. 5) Pedestrians were not familiar with traffic rules (such as pedestrians having the highest priority while crossing roads or that they have to wear reflective clothing during rain or night times), but they were found to support safety measures such as enforcing speed limit for drivers, banning street vendors on foot paths and banning on street parking.

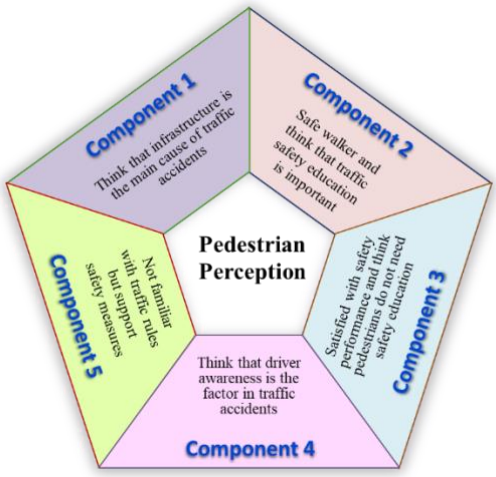



Figure 10. Pedestrian Perception Components derived from CATPCA

Table 4. Components of pedestrian perception and behaviour towards road safety

| | Component Loadings | | Mean | Median | Std. Dev |
|---|---|---|---|---|---|
| **Component 1: Think that infrastructure is the main cause of traffic accidents (Cronbach's α = 0.88)** | | | | | |
| C1e | Walking motivation: Tired of driving because of congestion | -0.11 | 0.49 | 0.00 | 0.50 |
| D1 | Ever Had Road Safety Education | 0.19 | 0.42 | 0.00 | 0.49 |
| D5d | Behaviour: Walk on the street (when footpaths are available) because of parked motorized vehicles | 0.38 | 3.67 | 4.00 | 0.95 |
| D5e | Behaviour: Walk on the street (when footpaths are available) because of street vendors | 0.43 | 4.09 | 4.00 | 0.92 |
| D6f | Satisfaction with number of streetlights | -0.43 | 2.37 | 2.00 | 0.69 |
| D6g | Satisfaction with number of places to cross the street | -0.39 | 2.19 | 2.00 | 0.70 |
| E2c | Likeliness of accident in crossing major or wide roads with dual carriage lanes | 0.68 | 3.99 | 4.00 | 0.81 |
| E2d | Likeliness of accident in crossing minor or narrow roads without any footpath | 0.59 | 3.57 | 4.00 | 0.89 |
| E4d | Cause of accident: Illegal on-street parking | 0.42 | 4.31 | 4.00 | 0.79 |
| E4e | Cause of accident: Lack of pedestrian traffic signal | 0.76 | 4.31 | 4.00 | 0.76 |
| E4f | Cause of accident: Lack of pedestrian crossing | 0.66 | 4.40 | 5.00 | 0.75 |
| E4g | Cause of accident: Lack of pedestrian bridge for road crossing | 0.59 | 4.20 | 4.00 | 0.87 |
| E4h | Cause of accident: Shortage of footpaths | 0.77 | 4.49 | 5.00 | 0.75 |
| E4i | Cause of accident: Shortage of streetlights | 0.67 | 4.17 | 4.00 | 0.84 |
| E4j | Cause of accident: Shortage of crash barrier (guardrails) | 0.77 | 4.16 | 4.00 | 0.86 |
| E4k | Cause of accident: Bad road surface | 0.59 | 4.23 | 4.00 | 0.84 |
| E5 | Time of Accidents | 0.26 | 4.03 | 4.00 | 1.75 |
| F1a | Road safety measure: Improving road infrastructure | 0.33 | 4.83 | 5.00 | 0.45 |
| F1e | Road safety measure: Dissemination of traffic education to drivers | 0.27 | 4.73 | 5.00 | 0.54 |
| **Component 2: Safe walker and think that traffic safety education is important (Cronbach's a = 0.83)** | | | | | |
| C1b | Walking motivation: Health reasons | 0.18 | 0.31 | 0.00 | 0.46 |
| C1c | Walking motivation: Environmental reasons | 0.24 | 0.32 | 0.00 | 0.47 |
| C1d | Walking motivation: Short distance to destination | 0.10 | 0.33 | 0.00 | 0.47 |
| D5b | Behaviour: Avoid certain streets or intersections as they are too dangerous related to the risk of accident | -0.39 | 3.67 | 4.00 | 0.95 |
| D5f | Behaviour: Make/answer a call with handheld phone | 0.17 | 2.24 | 2.00 | 0.99 |
| D5g | Behaviour: Use MP3/iPod/other music devices | -0.23 | 2.53 | 2.00 | 1.39 |
| D5h | Behaviour: Walk while having focus on other things than the roads or road environment | -0.32 | 2.74 | 3.00 | 1.07 |
| E1 | Ever been in a traffic accident as a pedestrian | 0.11 | 0.30 | 0.00 | 0.46 |
| E2a | Likeliness of accident in intersection/roundabout with traffic signals or traffic police | -0.38 | 2.79 | 3.00 | 0.95 |
| E2e | Likeliness of accident in footpath with heavy traffic | -0.34 | 3.34 | 3.00 | 1.03 |
| E2h | Likeliness of accident in/near the entrance/exit of parking | -0.37 | 3.19 | 3.00 | 0.91 |
| E3a | Main cause of accident: Car | 0.27 | 0.50 | 0.00 | 0.50 |
| F2c | Group to have traffic safety education: Car Driver | 0.49 | 0.76 | 1.00 | 0.43 |
| F2e | Group to have traffic safety education: Motorcycle rider | 0.29 | 0.94 | 1.00 | 0.24 |
| F2f | Group to have traffic safety education: Truck/Trailer Driver | 0.45 | 0.65 | 1.00 | 0.48 |
| F2g | Group to have traffic safety education: Cyclist | 0.50 | 0.51 | 1.00 | 0.50 |
| F3a | Road safety campaign: In schools | 0.28 | 0.66 | 1.00 | 0.48 |
| F3b | Road safety campaign: In road intersections | 0.25 | 0.47 | 0.00 | 0.50 |
| F3d | Road safety campaign: When getting a driving licence | 0.31 | 0.65 | 1.00 | 0.48 |

| | | | | | |
|---|---|---|---|---|---|
| F3e | Road safety campaign: Advertisement on TV or radio | 0.32 | 0.57 | 1.00 | 0.50 |
| F3f | Road safety campaign: Advertisement on social media | 0.29 | 0.79 | 1.00 | 0.41 |
| **Component 3: Satisfied with safety performance and think pedestrians do not need safety education (Cronbach's a = 0.78)** | | | | | |
| C1f | Walking motivation: Fear of driving/cannot drive | -0.15 | 0.20 | 0.00 | 0.40 |
| D2 | Safety level of roads in Jakarta | 0.36 | 0.42 | 0.00 | 0.49 |
| D3 | Government concerns on road safety | 0.43 | 2.20 | 2.00 | 0.63 |
| D6a | Satisfaction with pavements (footpaths) | 0.45 | 2.47 | 2.00 | 0.70 |
| D6b | Satisfaction with separation of pedestrian and cyclist | 0.43 | 2.13 | 2.00 | 0.76 |
| D6c | Satisfaction with safety | 0.49 | 2.17 | 2.00 | 0.67 |
| D6d | Satisfaction with speed of the traffic | 0.47 | 2.13 | 2.00 | 0.67 |
| D6e | Satisfaction with volume of traffic | 0.36 | 1.83 | 2.00 | 0.69 |
| E3c | Main cause of accident: Bus | -0.29 | 0.24 | 0.00 | 0.43 |
| E3d | Main cause of accident: Large-sized vehicle | -0.33 | 0.24 | 0.00 | 0.43 |
| E3e | Main cause of accident: Rail based vehicle | -0.27 | 0.09 | 0.00 | 0.29 |
| E3f | Main cause of accident: Bicycle | -0.15 | 0.03 | 0.00 | 0.18 |
| E4l | Cause of accident: Bad weather (heavy rain or fog) | 0.36 | 3.59 | 4.00 | 0.94 |
| F1f | Road safety measure: Dissemination of traffic education to pedestrian | 0.28 | 4.66 | 5.00 | 0.64 |
| F2a | Group to have traffic safety education: Pedestrian (School Children) | -0.45 | 0.82 | 1.00 | 0.38 |
| F2b | Group to have traffic safety education: Pedestrian (Adult) | -0.51 | 0.69 | 1.00 | 0.46 |
| F2d | Group to have traffic safety education: Bus/ Angkot/ Kopaja Driver | -0.32 | 0.86 | 1.00 | 0.34 |
| F3c | Road safety campaign: In social activities | -0.29 | 0.63 | 1.00 | 0.49 |
| **Component 4: Think that driver awareness is a factor in traffic accidents (Cronbach's a = 0.73)** | | | | | |
| E2b | Likeliness of accident in intersection/roundabout without traffic signals or traffic police | 0.62 | 4.18 | 4.00 | 0.86 |
| E2f | Likeliness of accident in sharp curved roads without footpath | 0.73 | 4.31 | 4.00 | 0.76 |
| E3b | Main cause of accident: Motorcycle | -0.16 | 0.93 | 1.00 | 0.25 |
| E4a | Cause of accident: Careless or inattentive driving | 0.62 | 4.56 | 5.00 | 0.60 |
| E4b | Cause of accident: Using cell phone while driving | 0.75 | 4.55 | 5.00 | 0.64 |
| E4c | Cause of accident: Speeding or aggressive driving | 0.61 | 4.64 | 5.00 | 0.64 |
| **Component 5: Not familiar with traffic rules but support safety measures (Cronbach's a = 0.66)** | | | | | |
| C1a | Walking motivation: Financial reasons | 0.17 | 0.40 | 0.00 | 0.49 |
| D4a | Knowledge: Pedestrians have to cross in the designated place (bridge or zebra crossing) when available | -0.09 | 0.98 | 1.00 | 0.15 |
| D4b | Knowledge: Pedestrians have the highest priority when crossing the road in the designated place | -0.39 | 0.82 | 1.00 | 0.38 |
| D4c | Knowledge: It recommended that pedestrians look right-left-right first before crossing | -0.23 | 0.95 | 1.00 | 0.21 |
| D4d | Knowledge: It is recommended that pedestrians wear light coloured/ reflective cloth in rain or nighttime | -0.40 | 0.30 | 0.00 | 0.46 |
| D4e | Knowledge: It is recommended to keep on the right-hand side of the road so that pedestrians can see traffic | -0.21 | 0.31 | 0.00 | 0.46 |
| D5a | Behaviour: Cross streets at places other than the pedestrian crossing when the facility is available | 0.23 | 2.66 | 3.00 | 1.01 |
| D5c | Behaviour: Wear light coloured or reflective clothing | 0.35 | 2.29 | 2.00 | 0.96 |
| E2g | Likeliness of accident in railway crossing point | 0.30 | 3.87 | 4.00 | 0.98 |
| F1b | Road safety measure: Speed limit enforcement for drivers | 0.34 | 4.64 | 5.00 | 0.63 |
| F1c | Road safety measure: Banning On-street parking | 0.45 | 4.68 | 5.00 | 0.63 |
| F1d | Road safety measure: Banning street vendors on footpath | 0.42 | 4.52 | 5.00 | 0.73 |

## 5. CONCLUSIONS

This study explores pedestrians' attitudes and perceptions of road safety through a tailored questionnaire administered in Jakarta. A comprehensive literature review identified key pedestrian safety issues, which informed the questionnaire design. The survey gathers socio-demographic data and addresses topics such as travel patterns, motivations for walking or using public transport, perceptions of road safety performance, traffic accidents, and safety measures in Jakarta. A total of 435 complete responses were analyzed, providing valuable insights into pedestrian experiences and perspectives on road safety in the city.

The primary objective of this study was to examine pedestrians' attitudes and perceptions of road safety in Jakarta. Descriptive analysis of survey responses provided valuable insights and highlighted several key findings. It was observed that most of the pedestrians in Jakarta were within the 15-29 age group. Additionally, a significant proportion of respondents were commuters from outside Jakarta who travel to the city almost daily. The majority of pedestrians commute for school or work and frequently rely on public transportation. Their preference for walking or using public transit is largely driven by congestion and financial considerations, underscoring practical motivations behind these choices.

In general, pedestrians were not satisfied with the traffic safety performance and believed that the roads in Jakarta were not safe to travel on. Pedestrians also felt that the government still had a lack of concern for road safety, despite data indicating a decrease in the fatality index rate in the past ten years in Indonesia. Moreover, a little over half of pedestrians in Jakarta had not received any road safety education, but they were generally aware of the rules when crossing the streets. However, the recommendation to wear clothing that is easily seen in the dark and to walk on the right side of the road where pedestrians can see the oncoming traffic were not commonly known amongst pedestrians in Jakarta. It was found that only a small portion of pedestrians reported often using light coloured or reflective clothing. In addition, most pedestrians in Jakarta reported walking in a safe manner unless an obstruction on the sidewalk directed them to walk on the main carriageway together with motorized vehicle traffic.

Pedestrians perceived sharp curved roads without a footpath as the most dangerous location on the road, followed by intersections without traffic signals or traffic police. Crossing major or wide roads with dual carriage lanes and railway crossing points were also placed in the top four most possible locations for accidents based on pedestrians' perceptions. Furthermore, motorcycles were chosen as the main cause of traffic accidents occurring in Jakarta. The majority of pedestrians in Jakarta agreed with the opinions on lack of infrastructure and risky driving behaviour as contributing factors to collisions in Jakarta. Moreover, it was indicated that more danger was perceived by pedestrians when more vehicles are present on the roads. This was in line with the conclusion derived by Herawati (2014) that most traffic collisions in Indonesia were occurring during the rush hour time. Another study (Hafeez *et al*., 2023) also found that traffic volume impacts road safety where risk of pedestrian accidents in urban areas increases with higher traffic flow.

Improving road infrastructure was selected to be the most important measure to improve traffic safety in Jakarta. Although pedestrians often had to walk on the main carriageway because of street vendors, banning street vendors on footpaths are the least popular measures compared to the others. Kweon *et al*., (2021) has shown that sidewalk availability, buffer zones, and trees on sidewalks improves pedestrians' perception on safety. Generally, pedestrians thought that traffic safety education was equally needed across all road users in Jakarta, as more than half of pedestrians agreed that each group of road users should receive traffic safety education. However, pedestrians considered the most notorious group in need of road safety education to be motorcyclists. This was in line with their opinion of motorcyclists

as being the most dangerous road user group on the road. In addition, pedestrians favoured safety campaigns through social media, rather than at road intersections, as the most effective method to disseminate safety awareness.

This study further explored the attitudes and perceptions of pedestrians toward road safety in Jakarta, uncovering five key underlying factors. First, pedestrians identified poor infrastructure as a major contributor to traffic accidents. They highlighted issues such as the lack of footpaths, pedestrian crossings, guardrails, pedestrian traffic signals, bad road surfaces, and illegal on-street parking as critical shortcomings. Second, pedestrians expressed strong support for safe walking behavior and emphasized the importance of traffic safety education for vehicle drivers. Third, some pedestrians reported satisfaction with safety performance, such as pavement conditions and traffic speed, and believed that safety education for pedestrians was unnecessary. Fourth, many pedestrians identified a lack of driver awareness—such as carelessness, cell phone usage, and aggressive driving—as significant causes of traffic accidents. Lastly, pedestrians demonstrated limited familiarity with traffic rules, such as the priority pedestrians have while crossing roads or the requirement to wear reflective clothing during rainy or nighttime conditions. However, they supported safety measures like enforcing speed limits for drivers, banning street vendors on footpaths, and prohibiting on-street parking.

## 6. REFERENCES


Abdi, H. and Williams, L. (2010) 'Principal component analysis'. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2(4), pp.433-459.

Althoff, T., Sosič, R., Hicks, J.L., King, A.C., Delp, S.L., Leskovec, J. (2017) 'Large-scale physical activity data reveal worldwide activity inequality', *Nature*, pp.336-339.

Bonnel, P. (2009) *Transport survey methods: keeping up with a changing world*. London: Emerald Group Publishing.

BPS Statistics Indonesia. (2019). *Statistical Yearbook of Indonesia*. Available at: Statistik Indonesia 2019 - Badan Pusat Statistik Indonesia

Choi, J., Tay, R., Kim, S. and Jeong, S. (2019) 'Behaviors of older pedestrians at crosswalks in South Korea'. *Accident Analysis & Prevention*, 127, pp.231-235.

Chu, W., Wu, C., Atombo, C., Zhang, H. and Özkan, T. (2019) 'Traffic climate, driver behaviour, and accidents involvement in China'. *Acc. Analysis & Prevention*, 122, pp.119-126.

CNN Indonesia (2018) 'Warga Nilai Pelican Crossing di Bundaran HI Tak Efektif'. CNN Indonesia. Available at: Warga Nilai Pelican Crossing di Bundaran HI Tak Efektif

Cordellieri, P., Sdoia, S., Ferlazzo, F., Sgalla, R. and Giannini, A. (2019) 'Driving attitudes, behaviours, risk perception and risk concern among young student car-drivers, motorcyclists and pedestrians in various EU countries. *Transportation Research Part F: Traffic Psychology and Behaviour*, 65, pp.56-67.

Costello, AB and Osborne, J. (2005) 'Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis'. *Practical Assessment, Research & Evaluation*, 10(7), pp.1-9.

DaCoTA. (2012) *Pedestrians and Cyclists*.

Deny. (2019) 'Trotoar Depan JIC Rusak, Pejalan: Kalau Lewat Bahu Jalan Rebutan Sama Mobil'.

European road users' risk perception and mobility: The SARTRE 4 Survey. Available at: http://www.attitudes-roadsafety.eu/home/publications/

Fan, M., Marzbali, M.H., Abdullah, A., Tilaki, M.J.M. (2024) 'Using a space syntax approach to enhance pedestrians' accessibility and safety in the historic city of George Town', Penang. *Urban Science*, 8(6). 23pp

Field, A.P. (2018) *Discovering statistics using IBM SPSS statistics,* 5th ed.
*Global Plan for the Decade Action for Road Safety*, 2011-2020, Version 3
Goldenbeld, C. and de Craen, S. (2013) 'The comparison of road safety survey answers between web-panel and face-to-face; Dutch results of SARTRE-4 survey'. *Journal of Safety Research*, 46, pp.13-20.
Hafeez, F., Sheikh, U. U., Al-Shammari, S., Hamid, M., Khakwani, A. B., & Arfeen, Z. A. (2023). 'Comparative analysis of influencing factors on pedestrian road accidents'. *Bulletin of Electrical Engineering and Informatics*, 12(1), 257–267.
Hamim, O.F., Ukkusuri, S.V. (2024) 'Towards safer streets: a framework for unveiling pedestrians' perceived road safety using street view imagery', *Accident Analysis & Prevention*, 195,107400.
Hinton, P.R., Brownlow, C., McMurray, I., Cozens, B. & Ebooks Corporation (2004) *SPSS Explained*. London: Routledge.
Kaiser, H. (1974) 'An index of factorial simplicity'. *Psychometrika*, 39(1), pp.31-36.
Kline, P. (2000) *The handbook of psychological testing* 2nd ed. London: Routledge.
Kweon, B.-S., Rosenblatt-Naderi, J., Ellis, C. D., Shin, W.-H., & Danies, B. H. (2021). 'The effects of pedestrian environments on walking behaviors and perception of pedestrian safety'. *Sustainability*, 13(16), 8728.
Linting, M. and van der Kooij, A. (2012) 'Nonlinear Principal Components Analysis With CATPCA: A Tutorial'. *Journal of Personality Assessment*, 94(1), pp.12-25.
Metrotvnews (2019) 'Satpol PP Bongkar Lapak PKL di Jakarta Utara'. Metrotvnews
MRT Jakarta (2019). 'Selama Juli 2019, Rata-rata 93.215 orang per hari Gunakan MRT Jakarta'. MRT Jakarta.
Mueller, N., Rojas-Rueda, D., Cole-Hunter, T., de Nazelle, A., Dons, E., Gerike, R., Götschi, T., Int Panis, L., Kahlmeier, S. and Nieuwenhuijsen, M. (2015) 'Health impact assessment of active transportation: A systematic review'. *Preventive Medicine*, 76, pp.103-114.
Murphy, K. and Davidshofer, C. (1988) *Psychological Testing: Principles and Applications*, Engle- wood Cliffs, NJ: Prentice-Hall.
Musselwhite, C., Avineri, E., Fulcher, E., Goodwin, P. and Susilo, Y. (2010) 'Understanding the public attitudes to road safety. A review of the literature 2000-2009'. *19th Behavioural Studies Seminar, Horsley Park, East Horsley, Leatherhead, 30 Mar- 1 April'09*.
National Criminal Information Centre (2024). *Jurnal Tahun 2023 Pusat Informasi Kriminal Nasional Bareskrim Polri Edisi Tahun 2024*
Ni, Y., Cao, Y. and Li, K. (2017). 'Pedestrians' Safety Perception at Signalized Intersections in Shanghai'. *Transportation Research Procedia*, 25, pp.1955-1963.
Norusis, M.J. (2011). *IBM SPSS Statistics 19 Procedures Companion*, Addison Wesley, TX.
Nugroho, I. (2019) 'Semrawutnya Parkiran Sepeda Motor di Trotoar Danau Sunter'. *Merdeka*.
Ortúzar S., J. de D. and Willumsen, L.G. (2011) *Modelling Transport*. Fourth edition. Chichester, West Sussex, United Kingdom: John Wiley & Sons.
Oxley, J., Fildes, B., Ihsen, E., Charlton, J., Day, R. (1997) 'Differences in Traffic Judgements Between Young and Old Adult Pedestrians', *Accident Analysis and Prevention*, 29, No. 6, pp. 839-847.
Papadimitriou, E., Lassarre, S. and Yannis, G. (2017). 'Human factors of pedestrian walking and crossing behaviour'. *Transportation Research Procedia*, 25, pp.2002-2015.
Papadimitriou, E., Theofilatos, A. and Yannis, G. (2013). 'Patterns of pedestrian attitudes, perceptions and behaviour in Europe'. *Safety Science*, 53, pp.114-122.

Papadimitriou, E., Theofilatos, A., Yannis, G., Sardi, G. and Freeman, R. (2012). 'Road Safety Attitudes and Perceptions of Pedestrians in Europe'. *Procedia - Social and Behavioral Sciences*, 48, pp.2490-2500.

Peterson, R. (1994). 'A Meta-Analysis of Cronbach's Coefficient Alpha'. *Journal of Consumer Research*, 21(2), p.381.

Putri, P. (2018). 'Melongok Efektivitas Pelican Crossing di Jakarta'. *detiknews*.

Ram, T. and Chand, K. (2016). 'Effect of drivers' risk perception and perception of driving tasks on road safety attitude'. *Transportation Research Part F*, 42, pp.162-176.

Ramadhan, A (2018). 'JPO Dinilai Lebih Efektif daripada Pelican Crossing'. *Kompas.com*

Rehman, A., Imran, S., Hassan, M., Akhlaq, A., Iqbal, S., Beg, F., Zahid, G., Khalid, H., Qadir, F., Murad, H., Baloch, N., Awais, M. and Saleem, S. (2015). 'Taxi drivers' attitudes toward road safety in Pakistan'. *Public Health*, 129(6), pp.818-821

Richardson, A.J., Ampt, E.S. & Meyburg, A.H. (1995) *Survey methods for transport planning*. Melbourne, Aust.: Eucalyptus Press.

Shiwakoti, N., Tay, R., Stasinopoulos, P., de Sousa, T., Barber, A. (2018) 'Development of On-site Poster to Influence Pedestrian Jaywalking Behavior'. *Australasian Transport Research Forum*.

Statistics of DKI Jakarta Province (2018) *Jakarta in Figures 2018*.

Stevens, J. (2002) *Applied multivariate statistics for the social sciences*. 4th ed. Mahwah, N.J.: Lawrence Erlbaum Associates.

Tainio, M., de Nazelle, A., Gotschi, T., Rojas-Rueda, D., Kahlmeier, S., Nieuwenhuijsen, M., de Sa, T., Kelly, P. and Woodcock, J. (2016). 'Can Air Pollution Negate the Health Benefits of Cycling and Walking?'. *Journal of Transport & Health*, 3(2), p.S54.

Taubman - Ben-Ari, O. and Shay, E. (2012). 'The association between risky driver and pedestrian behaviors: The case of Ultra-Orthodox Jewish Road users'. *Transportation Research Part F: Traffic Psychology and Behaviour*, 15(2), pp.188-195.

Thibenda M, Wedagama DMP, Dilum Dissanayake D. **(**2022) Drivers' attitudes to road safety in the Southeast Asian cities of Jakarta and Hanoi: Socio-economic and demographic characterisation by Multiple Correspondence Analysis**.** *Safety Science***,** 155**,** 105869**.**

Tsuji, I., Takahashi, K., Nishino, Y., Ohkubo, T., Kuriyama, S., Watanabe, Y., Anzai, Y., Tsubono, Y. and Hisamichi, S. (2003) 'Impact of walking upon medical care expenditure in Japan: The Ohsaki Cohort Study'. *International Journal of Epidemiology*, 32(5), pp.809-814.

Umniyatun, Y. Nurmansyah MI, Farradika Y, Purnama TB, Hidayat DN. (2021) 'Motorcycle risky behaviours and road accidents among adolescents in Jakarta metropolitan area, Indonesia', *Int. Journal of Injury Control and Safety Promotion*, 28(3), pp. 339–346.

World Health Organization (2004) *World report on road traffic injury prevention*.

World Health Organization (2013) *Pedestrian Safety*

World Health Organization (2016) *Global Health Observatory (GHO) Data*.

World Health Organization (2018) *Global Status Report on Road Safety 2018*.

Wu, X., Xiao, W., Deng, C., Schwebel, D. and Hu, G. (2019). 'Unsafe riding behaviors of shared-bicycle riders in urban China: A retrospective survey'. *Acc.t Analysis & Prevention*, 131, pp.1-7.

Xu, J., Ge, Y., Qu, W., Sun, X. and Zhang, K. (2018). 'The mediating effect of traffic safety climate between pedestrian inconvenience and pedestrian behavior'. *Accident Analysis & Prevention*, 119, pp.155-161.

Yusuf, Y. (2019) 'Koalisi Pejalan Kaki Sebut 50 persen JPO di Jakarta Tidak Aman'. *SINDOnews*. Available at: Koalisi Pejalan Kaki Sebut 50 persen JPO di Jakarta Tidak Aman