CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol. 12 No.3 September 2025
http://cived.ppj.unp.ac.id/index.php/CIVED

Analysis of Pedestrian Safety Level Using Pedestrian Risk Index (PRI) for Student Pedestrians at SMAN 1 Gunung Talang

Rizky Indra Utama[1*], Darma Hendra[2]
[1] Civil Engineering, Faculty of Engineering, Universitas Negeri Padang, Indonesia
[2] Civil Engineering, Politeknik Negeri Padang, Indonesia
* Corresponding Author, e-mail: rizkyindrautama@ft.unp.ac.id

Received 12th June 2025; Revision 18th July 2025; Accepted 15th September 2025

ABSTRACT

Pedestrians are the most vulnerable road users. If involved in an accident, the risk of fatality they face is greater than that of other road users (Shinar, 2007). This study aims to analyze the level of safety for pedestrians based on the level of risk expressed by the Pedestrian Risk Index (PRI). The case study was conducted on pedestrian students at SMAN 1 Gunung Talang. The data in this study are traffic conflict data obtained from analysis of field observations. The data required in calculating the Pedestrian Risk Index (PRI) were obtained from field observations. The observations were conducted over two days, namely Monday and Tuesday, where the morning survey was conducted from 06.30 - 07.30 when students entered school and in the afternoon from 15.00 - 16.00 when students returned from school. The data were further analyzed to obtain the Pedestrian Risk Index (PRI) value. The results of the data analysis show that there are differences in PRI values based on the day and time of the crossing, namely crossings carried out in the morning have a higher average PRI value of 124.91 than crossings in the afternoon with an average PRI value of 61.55. Based on this study, it can be concluded that crossings carried out in the afternoon have a higher level of safety compared to crossings carried out in the morning.

Keywords: *Safety Level; Pedestrians; Traffic Conflicts; Pedestrian Risk Index (PRI).*

DOI: https://doi.org/10.24036/t3tdkd60

INTRODUCTION

Pedestrians are one of the road users most vulnerable to the risk of serious injury and fatalities due to traffic accidents. The Global Status Report on Road Safety 2023 shows that more than half of the victims who died in traffic accidents worldwide were vulnerable road users, including pedestrians, cyclists, and motorcyclists, with pedestrians contributing approximately 23% of the total traffic accident fatalities [1]. This condition has the potential to occur on the Padang-Solok Highway in front of SMAN 1 Gunung Talang. As a national road that serves traffic with a relatively high volume of vehicles and heavy student crossing activity during school hours, this area has a significant potential for traffic conflict. This risk is further increased by side obstacles in the form of illegal parking of public transportation that utilizes part of the road and reduces visibility for road users. In addition, the limited availability of crossing facilities, such as zebra crossings and other school safety facilities, causes students to frequently perform risky crossing maneuvers, increasing the possibility of conflict between vehicles and pedestrians [4].

To proactively evaluate the safety level at a location before an accident occurs, the traffic conflict approach can be used as an alternative road safety analysis. This method is considered effective because it is able to identify the level of risk based on the interaction between vehicles and pedestrians without having to wait for an actual accident to occur [2]. One method that can be used is the Pedestrian Risk Index (PRI), which measures the level of risk at a crossing based on the temporal parameters of the interaction between vehicles and pedestrians. The PRI analysis integrates several key parameters, namely Time to Collision of Vehicle (TTCv) which indicates the time required for a vehicle to reach the point of conflict, Time to Collision of Pedestrian (TTCp) which indicates the time required for a pedestrian to reach the point of conflict, and Vehicle Time to Stopping (Ts) which describes the minimum time required for a vehicle to stop safely. The conflict phase occurs when $TTCp \leq TTCv \leq Ts$, which indicates the potential for a collision if no avoidance action occurs. The risk level is then calculated based on the duration of the conflict and the speed of the vehicle impact (Vimpact), so that it can provide a quantitative picture of the level of danger experienced by pedestrians when crossing [3].

Based on these conditions, this study aims to analyze the safety level of students crossing the road in front of SMAN 1 Gunung Talang using the Pedestrian Risk Index (PRI) method. The analysis was carried out by measuring traffic conflict parameters that occurred in the field so that a quantitative picture of the level of risk of crossing during the morning and evening rush hours was obtained. The results of the study are expected to be a scientific basis in developing strategies to improve road safety, especially for school-age pedestrians, as well as being input for the Solok Regency Transportation Agency and related agencies in implementing vehicle speed management and providing school road safety facilities such as the School Safety Zone (ZoSS) in order to create a safer traffic environment for students [4].

Although many studies on pedestrian safety have been conducted, most of the research still focuses on crash-based analysis or evaluation of crossing facilities based on geometric characteristics and traffic volume [7],[8]. This approach has limitations because it relies on data on accidents that occur relatively rarely (rare events) and are often incompletely documented, especially in locations with low accident rates or inadequate reporting [2]. Meanwhile, traffic conflicts that occur between vehicles and pedestrians have a higher frequency and can be used as an early indicator of potential accidents at a location [2][5]. Therefore, the traffic conflict analysis approach is considered more proactive in identifying the level of safety risk before an accident actually occurs [6],[9].

In Indonesia, the application of the Pedestrian Risk Index (PRI) method in school areas is still relatively limited, especially on national roads that have mixed traffic characteristics, high levels of side obstacles, and intensive student crossing activities. These conditions cause interactions between vehicles and pedestrians to be more complex compared to urban areas that already have adequate crossing facilities [3] [10]. Therefore, this study is expected to provide an empirical picture of the level of risk of student crossing based on traffic conflict parameters that occur in the field.

In addition to producing a pedestrian risk index value, this study also identifies the influence of traffic characteristics, vehicle speed, and pedestrian behavior on the level of risk that occurs. Vehicle speed is one of the most influential factors on the severity of pedestrian accidents, where increasing speed will significantly increase the probability of collisions and fatalities [1]

CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol. 12 No.3 September 2025
http://cived.ppj.unp.ac.id/index.php/CIVED

[11]. The results of this study are expected to provide a more comprehensive basis for planning school road safety facilities and become a reference in determining pedestrian safety priorities on the Padang-Solok Highway in front of SMAN 1 Gunung Talang. The findings of this study can also support the provision of school road safety facilities, such as School Safety Zones (ZoSS), as an effort to improve the safety of vulnerable road users, especially school students [4].

METHOD

This study used quantitative field observation to analyze traffic conflicts. Data collection was conducted on the Padang-Solok Highway, specifically in the area of SMAN 1 Gunung Talang. The survey was conducted over two days, Monday and Tuesday, focusing on peak student traffic hours. Observations were conducted between 6:30 and 7:30 a.m. Western Indonesian Time (WIB), representing school start times, and 3:00 and 4:00 p.m. Western Indonesian Time (WIB), representing school closing times.

Primary data were collected through direct observation by two observers. Observer A stood at the edge of the road in the crossing area using a stopwatch to measure the vehicle's travel time and the student's crossing time. When the pedestrian began to walk, Observer A signaled to Observer B, who was already 50–60 meters away from the direction the vehicle was coming from. Observer B then marked the vehicle's position on the road. After traffic conditions were safe, the distance between the vehicle's positions was measured using a meter. Sampling was carried out five times for each observation period in the field.

The field data obtained included vehicle travel time, the distance between the vehicle and the crossing, the distance between the vehicle and the roadside, and the distance between the pedestrian and the conflict area. These data were further analyzed to obtain the Time to Collision of Vehicle (TTCv), Time to Collision of Pedestrian (TTCp), and Vehicle Time to Stopping (Ts) values. A comparison of these three temporal parameters was used to identify the phases of events in the conflict area. For samples identified as entering the conflict phase, vehicle collision speed (Vimpact) was calculated and then converted into a Pedestrian Risk Index (PRI) value to determine the level of safety risk.

RESULTS AND DISCUSSION

Traffic and Pedestrian Characteristics

Based on field observations, differences in vehicle speed characteristics were found during morning and evening rush hours. Average vehicle speeds were recorded higher in the morning than in the afternoon, with the highest average speed peaking on Monday morning at 9.92 m/s. Conversely, the lowest average speed occurred on Tuesday afternoon, at 8.02 m/s. This comparison of average vehicle speeds can be seen more clearly in Figure 1.

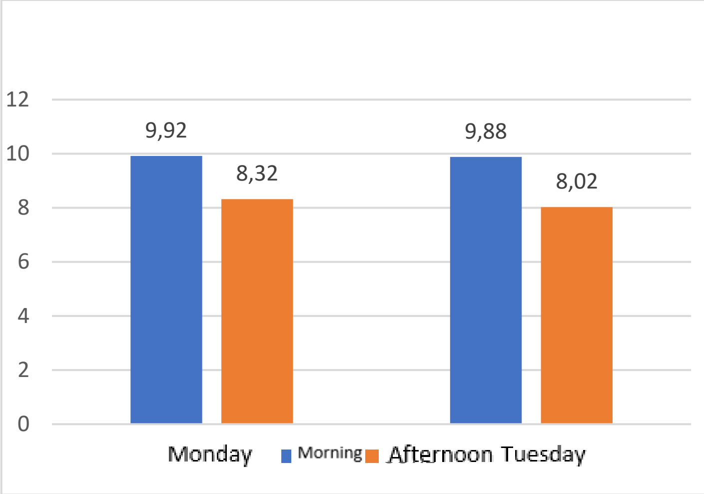

Figure 1. Average vehicle speed graph

The decrease in speed this afternoon was driven by high side obstacles, such as the large number of street vendors and public transportation vehicles parked on the shoulder of the road to wait for students to go home. Furthermore, in terms of pedestrian characteristics, the majority of students at SMAN 1 Gunung Talang tended to cross in groups (platoons) rather than individually.

Analysis of the Number and Type of Crossers

The graph below shows that the majority of pedestrians tend to travel in groups. Of the 10 samples observed each day, an average of more than 5 were in groups, while the average number of solo pedestrians was less than 5.

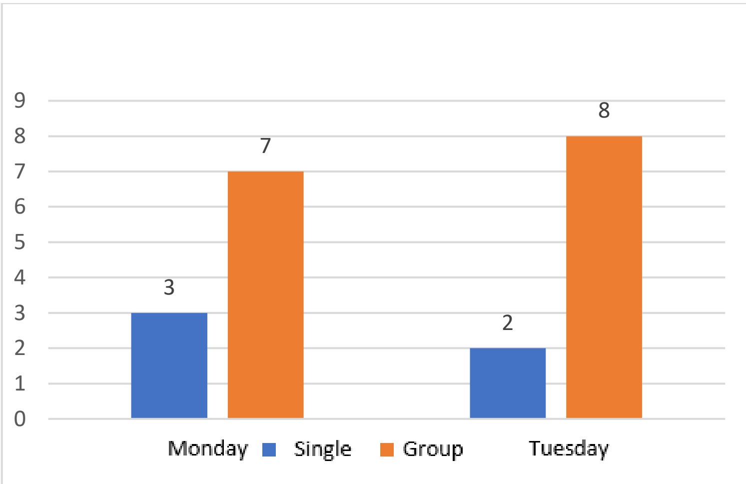

Figure 2. Number and Type of Crossers Per Day

Traffic Conflict Phase Analysis

The conflict phase was analyzed by comparing three time parameters, namely Time to Collision of Vehicle (TTCv), Time to Collision of Pedestrian (TTCp), and Vehicle Time to Stopping (Ts). From the data processing results, it was found that the average vehicle required a stopping time (Ts) of 3.3 seconds before reaching the conflict area. Based on Figure 2, the results of the temporal parameter comparison indicate that the most vulnerable point for direct conflict (conflict phase) between vehicles and pedestrians mostly occurred in the 3rd and 4th seconds.

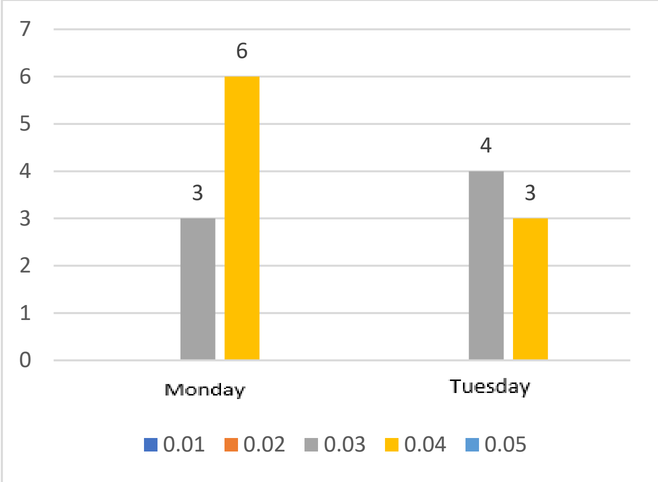

Figure 3. Graph of the number of conflict phases

At the 5th second, both vehicles and pedestrians have generally successfully passed the conflict area (passing phase).

V Impact Analysis

From the analysis results of 10 samples taken per day, only 7 out of 10 samples have a conflict phase, samples that do not have a conflict phase are sample P1, sample S1, sample S4. The highest average Vimpact analysis results on Monday occurred at the 3rd second, namely 16.37 and the lowest average Vimpact occurred at the 4th second, namely 15.07.

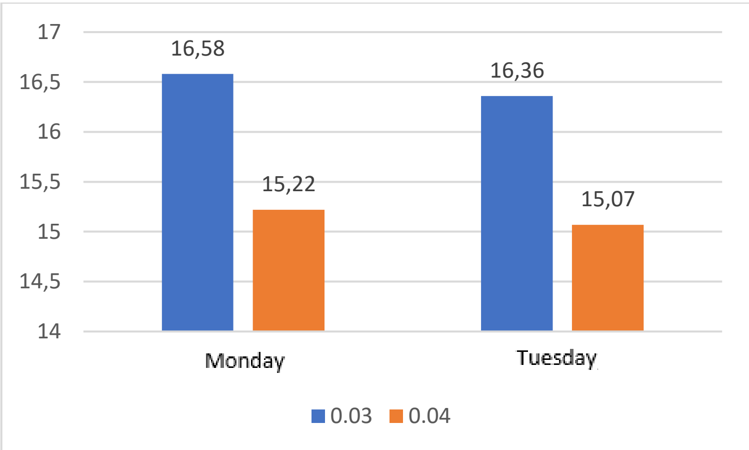

Figure 4. Average V Impact

PRI Value Calculation

The final parameter needed to calculate the accident risk level (PRI) is impact, or collision speed. The analysis shows that the average (PRI) or accident risk on Monday was 106.87, and the average (PRI) on Tuesday was 87.04.

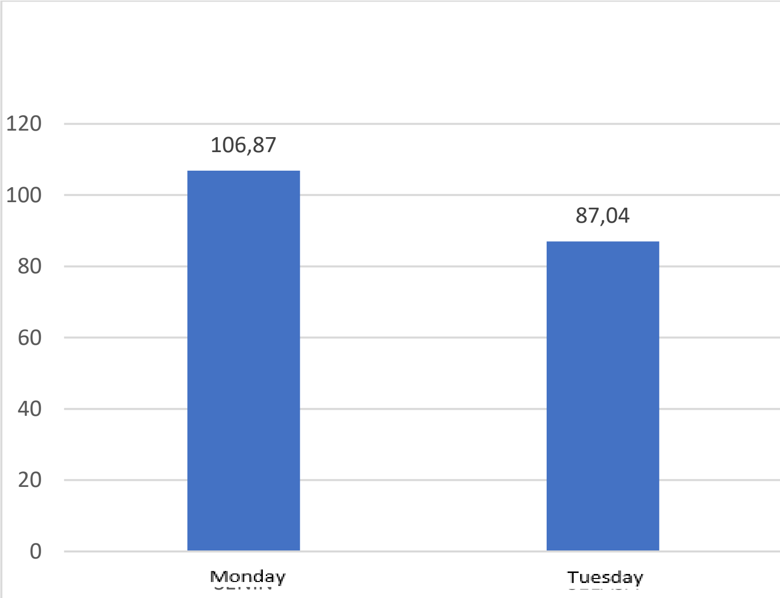

Figure 5. Graph of Average Pedestrian Risk Index Values

Safety Risk Level (Pedestrian Risk Index)

The safety risk level, or Pedestrian Risk Index (PRI), is determined based on the duration of the conflict phase multiplied by the square of the vehicle collision speed (V impact). The highest average collision speed was recorded on Monday at 16.58 m/s, while the lowest occurred on Tuesday at 15.07 m/s. This difference in collision speed directly affects the resulting PRI value. Details of the average PRI calculation based on crossing hours are presented in Table 1.

Table 1. Average PRI calculation based on crossing hours

Day	Morning	Afternoon
Monday	147,87	55,61
Tuesday	101,95	67,49
Average	124,91	61,55

Overall, the analysis shows that the average PRI score on Monday (106.87) was significantly higher than on Tuesday (87.04) due to the heavier traffic conditions at the start of the week. When viewed from the crossing time, crossings during school hours (in the morning) have a significantly higher risk of fatal accidents. The average PRI score in the morning reached 124.91, in stark contrast to the average PRI score in the afternoon of only 61.55.

The high risk score (PRI) in the morning is directly proportional to the high speed of vehicles passing through, due to the relatively smoother roads. Conversely, in the afternoon, the presence of illegally parked public transportation vehicles does create congestion that impedes traffic flow. However, this congestion indirectly reduces vehicle speed, thus reducing fatalities or the risk of pedestrian accidents.

CONCLUSION

Based on the results of the traffic conflict analysis, it can be concluded that the level of pedestrian safety risk in the SMAN 1 Gunung Talang area is much higher in the morning compared to the afternoon. The average Pedestrian Risk Index (PRI) value during school hours (morning) reached 124.91, a stark contrast compared to the school hours (afternoon) which was

Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol. 12 No.3 September 2025
http://cived.ppj.unp.ac.id/index.php/CIVED

at 61.55. The high risk in the morning is triggered by faster vehicle speeds, while in the afternoon, the presence of public transportation that takes up the road creates congestion that indirectly forces vehicle speeds to decrease. In addition, the accumulation of traffic movements at the beginning of the week makes the average PRI on Monday (106.87) higher than Tuesday (87.04). As a proactive mitigation measure to reduce this risk level, it is highly recommended to implement vehicle speed management in the surrounding area, provide assistance from crossing officers at crucial hours, and design a comprehensive School Safety Zone (ZoSS) to ensure pedestrian safety.

REFERENCE

[1] World Health Organization. (2023). Global Status Report on Road Safety 2023. Geneva: WHO.

[2] Hydén, C. (1987). The Development of a Method for Traffic Safety Evaluation: The Swedish Traffic Conflicts Technique. Lund University, Sweden.

[3] Alhajyaseen, W. K. M., Nakamura, H., Asano, M., & Sayed, T. (2012). Development of new metrics to evaluate the safety of pedestrian crossings based on vehicle–pedestrian interactions. Transportation Research Record, 2299(1), 76–84.

[4] Direktorat Jenderal Perhubungan Darat. (2014). Pedoman Teknis Zona Selamat Sekolah (ZoSS). Jakarta: Kementerian Perhubungan Republik Indonesia.

[5] Gettman, D., & Head, L. (2003). Surrogate Safety Measures from Traffic Simulation Models. Transportation Research Record, 1840(1), 104–115.

[6] Laureshyn, A., Svensson, Å., & Hydén, C. (2010). Evaluation of Traffic Safety, Based on Micro-level Behavioural Data: Theoretical Framework and First Implementation. Accident Analysis & Prevention, 42(6), 1637–1646.

[7] Elvik, R. (2008). Road Safety Management by Objectives: A Critical Analysis of the Norwegian Approach. Accident Analysis & Prevention, 40(3), 1115–1122.

[8] Lord, D., & Mannering, F. (2010). The Statistical Analysis of Crash-Frequency Data: A Review and Assessment of Methodological Alternatives. Transportation Research Part A, 44(5), 291–305.

[9] Sayed, T., & Zein, S. (1999). Traffic Conflict Standards for Intersections. Transportation Planning and Technology, 22(4), 309–323.

[10] Basile, O., Persia, L., & Usami, D. S. (2010). A methodology to assess pedestrian crossing safety. European Transport Research Review, 2(3), 129–137

[11] Rosén, E., & Sander, U. (2009). Pedestrian Fatality Risk as a Function of Car Impact Speed. Accident Analysis & Prevention, 41(3), 536–542.

[12] S. Cafiso, M. Alfonso, and R. Rojas, "Crosswalk Safety evaluation using a Pedestrian Risk Index as Traffic Conflict Measure,", pp. 1–15.

[13] C. F. Daiyah, "Beberapa Faktor Penyebab Kecelakaan di Indonesia," *Jurnal Ilmu Teknik*, vol. 2, no. 2, pp. 1–9, 2022.

[14] Departemen Pekerjaan Umum, "Tata Cara Perencanaan Fasilitas Pejalan Kaki di Kawasan Perkotaan, No. 011/T/Bt/1995," Jakarta, 1995.

[15] U. Enggarsasi, "Kajian Terhadap Faktor-Faktor Kecelakaan Lalu Lintas," *Perspektif*, vol. 22, no. 3, pp. 228–237, 2017.

[16] Kementerian Pekerjaan Umum, "Pedoman Perencanaan, Penyediaan, dan Pemanfaatan Prasarana dan Sarana Jaringan Pejalan Kaki di Kawasan Perkotaan, Nomor 03/PRT/M/2014," Jakarta, 2014.

[17] P. G. G. Saragih and Y. Aswad, "Analisa Kecelakaan Lalu Lintas di Kota Pematang Siantar," *Jurnal Teknik Sipil USU*, vol. 2, no. 3, 2013.