Bicycle Crash Analysis Along the Regional Central Business District in the City of San Fernando, Pampanga

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Abstract: - This paper delves into the analysis of bicycle crashes along the Regional Central Business District in the City of San Fernando, Pampanga. The researchers investigated bicycle crashes, the safety of cyclists, and the factors contributing to the collision. Using a combination of quantitative and qualitative research, which is a mixed-type method of research design, the gathered data from T-test statistics revealed the adherence of the bicycle facilities in the City of San Fernando to the minimum requirement of AASHTO's Guide for the Development of Bicycle Facilities, and survey questionnaires focused on the profile of the respondents, the frequency of cyclists using a bicycle, the context of bicycle crashes, the condition of the road and the weather, and the type of bicycle accident in which they were involved. Findings revealed that the City of San Fernando's bicycle facilities complied with the minimum requirements of AASHTO. Results also show that obstructions are the primary cause of accidents, as mentioned by the bicyclist, and the most preferred preventive measure to mitigate bicycle crashes is to have a physically separated bicycle lane.

Key Words: — ***Bicycle, Crash, Analysis, Bike Lanes.***

I. INTRODUCTION

Bicycles have been used as a form of transportation for hundreds of years. In the 1880s, bicycles were introduced to the archipelago and rapidly became a popular mode of transportation during Spanish colonial control of the Philippines, especially among the indigenous mestizo people. In today's world, despite the fact that several individuals currently prefer to commute by vehicle, a considerable number of people still enjoy riding bicycles. Bicycles have been recognized as an important mode of non-motorized transportation in order to increase transit efficiency, reduce air and noise pollution, and diminish traffic congestion. Increased population densities and social attitudes toward sustainability have been important driving forces in the advancement of cycling in recent years. People ride bicycles for various reasons. Some individuals ride bicycles for recreational purposes or to run errands, while others ride bikes to relax and unwind after a long day. Regardless, it is crucial to determine the risk factors for bicycle crashes.

Amidst public transportation suspensions and restrictions caused by the surge of the coronavirus disease (COVID-19) pandemic, bicycles have rapidly become a convenient and safe alternative mode of transportation. Because of the enormous growth in sales, bicycle shops have been given essential status, allowing them to remain open and provide services to bicycle commuters. Bicyclists in the CSFP should prepare for an upsurge in traffic accidents now that traffic has returned to the pre-pandemic level. Due to vehicles' presence, most urban areas

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were considered dangerous because of the lack of protective cycling infrastructure. However, statistics have consistently indicated that the increasing number of bicyclists on the road has had an unintended consequence during the last two years: a rise in bicycle crashes.

Based on observations around the area, the researchers identified risk factors contributing to bicycle crashes, such as obstructions (trees and street vendors) in the bicycle lanes, setbacks that were too far forward, parked vehicles, and motorized vehicles entering unprotected bicycle lanes to turn or overtake. Rationally, bicycle crashes will continue to occur as long as these contributing factors are present. Thus, researchers are highly motivated to analyze bicycle crashes and recommend ways to mitigate the risk factors mentioned.

II. METHODS

This research aimed to investigate the bicycle incident and identify the factors that led to the collision within the regional central business district in the City of San Fernando, Pampanga. In order to answer the research problem, the researchers employed a mixed-methods research design. The City Public Order and Safety Coordinating Office's (CPOSCO) Bicycle Facilities Plan and the National Association of City Transportation Officials (NACTO) Guide for the Development of Bicycle Facilities (2012) were compared using t-test statistics as a sample of quantitative research. These statistics provided a strong indication of whether bicycle facilities in the City of San Fernando, Pampanga, adhere to the minimum requirement. In contrast, a qualitative research approach involves the participants' observations, in which bicycles participate in a survey regarding their experience, ideas, and opinions on the issue of bicycle collisions.

Purposive sampling is suitable when doing transportation-related studies since only random commuters that are available are suited to helping out with the research study at that specific time. This strategy is also known as judgment sampling since it entails making a conscious decision to select a participant based on the attributes that the individual currently has. Also, the purposive sampling method does not use randomness and does not require a particular number of participants. To put it more simply, the researcher determines what information is required and then searches for individuals who are able to and are willing to supply it on the basis of their expertise or experience (Ilker, 2015). Furthermore, the study included a sample size of 87 bikers from San Fernando City. The samples for this study were chosen using non-probability or non-random sampling, with the samples chosen on the basis of purposive sampling.

In order to determine the causes of bicycle crashes, the researchers conducted a survey to determine the factors bicyclists consider contributing to risk factors. In accordance with Republic Act No. 10173, also known as the Data Privacy Act of 2012, all information acquired for this study will be kept fully private to the fullest extent permitted by law. The data will be strictly protected, with only researchers and research advisers having access. These data will be statistically analyzed using Spearman Rank Correlation to determine if the relationship between two variables is one of the factors that affect bicycle collisions and descriptive statistics to determine whether roadway behaviors negatively affect the frequency of bicycle collisions in the regional central business district in the City of San Fernando, Pampanga. These data were also presented in different relevant ways, such as charts, graphs, and other data visualization tools, to help the researchers draw conclusions and make recommendations in this study. Lastly, the researchers compared the data from the bicycle plan of the City Public Order and Safety Coordinating Office's (CPOSCO) Bicycle Facilities Plan and the AASHTO Guide for the Development of Bicycle Facilities (2012) by the National Association of City Transportation Officials (NACTO) using t-test statistics. The outcome was used to determine whether CPOSCO's bicycle plan adheres to AASHTO's minimum requirement.

III. RESULTS AND DISCUSSION

The findings are presented under the following headings: demographic profile; cycling exposure; context of bicycle crash accidents; meteorology and road surface; and type of bicycle accident. The standards were also examined in order to determine whether the cycling facilities along the study area meet the minimum requirements established by AASHTO.

Table.1. Location of the collision.

	Frequency	Percentage (%)
MacArthur Highway	39	44.83%
Lazatin Boulevard	23	26.44%

Capitol Boulevard	19	21.84%
Others (Outside Pampanga)	6	6.90%

It was discovered that 44.83% of respondents have been in bicycle accidents on MacArthur Highway. Based on the respondents, the bike accidents that they experienced were mostly located on MacArthur Highway. This means that the results discussed are associated with the said location. Although this does not indicate that the problems do not exist in other locations and do not need any proper attention.

Table.2. Comfort level when cycling on the target area.

	Frequency	Percentage (%)
Physically Separated Bike Lanes	78	89.66
Bicycle Traffic Lights	3	3.45
Road Signs	6	6.9

The results are shown in Table 7 wherein respondents made suggestions for comfortability and safety when cycling around MacArthur Highway, Lazatin, Blvd., and Capitol Blvd. It indicates that 78 (89.66%) respondents answered that physically separated bike lanes would make them feel comfortable and safer. Also, the collision with obstructions got the highest percentage. Therefore, this proves that the observed problem has a major contribution to the bicycle crashes that happened around the target area.

3.1 Relationship of Cycling Exposure and Crash Accidents

In order to reveal the association between cycling exposure and crash accidents, certain measures were created to represent these variables of interest.

Table.3. Association between Cycling Exposure and Crash Accidents

Variable	Derivation	Rationale
Cycling Exposure	The variable is calculated using the formula: CE=Frequency + Usage + Overall Cycling Experience + Comfort Level 4 where: ● *Frequency*: 1 - Occasionally; 2-Daily ● *Usage:* 1 - Recreational; 2 - Utilitarian ● *Overall Cycling Experience*: 1 - Very Satisfied; 2 - Somewhat Satisfied; 3- Satisfied; 4- Very Satisfied ● *Comfort Level*: 1 - Very Comfortable; 2 - Comfortable; 3 - Somewhat Comfortable; 4 - Not Very Comfortable	The cycling exposure variable is quantified by taking the average of the three components: frequency, usage, overall cycling experience, and comfort level. The scales for frequency and usage were adjusted to make them 1-4, like the scales for overall cycling experience and comfort level.
Crash Accident	CA=Injury + Crash Involvement + Crash Location 3 where: ● *Injury:* 1 - Minor; 2 - Major ● *Crash Involvement*: 1 - 1-5 times; 2 - 6-10 times; 3 - more than 10 times ● *Crash Location*: 1 - MacArthur Highway; 2 - Lazatin Boulevard; 3 - Capitol Boulevard; 4 - Others	The crash accident variable was measured by getting the average of the three components: injury, crash involvement, and crash location. The scales for injury and crash involvement were adjusted to make them 1-4, like the scale for crash location.

Table.4. Spearman's Rank Correlation Coefficients of Cycling Exposure and Crash Accident

	Test Used	**Coefficient**	**p-value**
Correlation of Cycling Exposure and Crash Accident	Spearman's Rank Correlation	0.197	0.067

The paired variable has a p-value that is less than the level of significance of 0.10, as determined by the correlation analysis. The null hypothesis is thus rejected at a significance level of 0.10 due to the presence of adequate data. The computed value of the coefficient is 0.197, which indicates that the correlation of cycling exposure is directly proportional to crash accidents,

or simply, the higher the cycling exposure, the higher the crash accident. S There is sufficient evidence to demonstrate that there is a significant relationship between cycling exposure and crash accidents, as the p-value of 0.067 is below the significance level of 0.10.

3.2 Relationship of CPOSCO Bicycle Facilities Plan and AASHTO Guide for the Development of Bicycle Facilities (2012) by NACTO

Table.5. T-test of Bicycle Facilities

Comparison between AASHTO's Minimum Requirements and CPOSCO Cycling Facilities	Test Used	Test t	Critical Value	P-Value
No Curb and gutter/no parking (4 ft)	T-Test	9.647	1.761	0
Curb and gutter/ no parking (5 ft)		5.397	2.015	0.000834
Parking (5 ft)		7.833	1.753	0.000001

The calculated t is below the critical value, and the paired variables have a p-value less than the 0.05 significance level based on the t-test analysis. In this manner, at a 0.05 degree of importance, there is adequate proof to dismiss the invalid speculation. Under a typical bike lane cross-section, it is possible to draw the conclusion that the bicycle facilities at the CSFP meet the minimum requirements set forth by AASHTO. However, based on visual observation, the road signs and bike lanes themselves are not visible. It was also observed that the bicycle lane does not exist in some parts of the study area.

IV. CONCLUSION

Although the findings show that the CSFP bicycle lane adheres to AASHTO's minimum requirements in a typical bike lane cross-section, 46.43% of the respondents still have concerns regarding obstructions such as trees, vendors, illegal parking, and motor vehicles. Motor vehicles are also considered obstructions because they frequently intrude into bicycle lanes, even though they are not intended for them. The researchers asked the respondents for suggestions to address these concerns and help the government improve the bike facilities. The survey results indicate that 63% of them suggested having physically separated bike lanes. Winter (2019) mentioned that bike lanes without physical barriers are more likely to cause road accidents, and that physically separated lanes are safer. Based on the results of this study and the aforementioned studies, we can conclude that it would be safer for cyclists to ride along the CSFP bicycle facilities if there were physical barriers such as raised curbs, planters, collapsible bollards, etc.

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