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PROACTIVE TRAFFIC CONTROL STRATEGIES AND ROAD SAFETY IN URBAN KISUMU, NYANZA REGION IN KENYA

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Abstract: **Road safety in urban areas of Kisumu County was an illusion despite the existence of Kenya's potentially enabling road safety policy, which offers due guidance for proactive road traffic controls. Such road safety concerns in that part of Kisumu led to a lingering question because of scanty explanations of the dilemma in previous road safety research and policy reports. In light of this knowledge lacuna, this study sought to investigate the effectiveness of proactive traffic strategies on road safety in urban Kisumu that forms the most complex road transport system in the Nyanza region of south western Kenya. The strategies specifically assessed include designation of road use sideways, enforcement of automobile safety requirements and use of vehicle speed control gadgets. The study adopted descriptive correlational research design based on the quantitative and qualitative approach. The field survey involved a sample of 365 respondents selected from the accessible population 1919 persons using purposive and stratified random sampling strategies. The study found out that the level of road safety was relatively high in urban Kisumu. In particular, road fatality was only relatively reduced on urban roads in Kisumu County. The study findings show that the level of road safety was correspondingly attributed to discrepancies in designating road use sideways, enforcing automobile safety requirements and in the use of vehicle speed control gadgets. Specifically, road side ways were only fairly designated. Automobile safety requirements were only relatively enforced and vehicle speed control gadgets were less used in the urban territories Kisumu. Particularly, designation of road side ways predicted 42.4%, enforcement of automobile basic safety requirements predicted 36.2% and the adoption of safe driving regulator mechanisms predicted 33.4% of road safety in such areas. It was concluded that road safety in urban Kisumu had a very significant bearing on the three proactive traffic control strategies. Urban Kisumu, with moderate performance of these strategies, registered relative road safety. Nonetheless, urban Kisumu areas had lot more to do with such traffic control activities to boost road safety that was just average. It was therefore recommended that Kenya's State Departments for Transport and Infrastructure, Kisumu County Government, the private sector and all other road users in the urban Kisumu should collectively help bolster proactive traffic control as required by Kenya's road safety policy. All stakeholders can do that by going about their road use responsibilities in a fashion that ensures best practice regarding proactive of traffic control.**

Keywords: **proactivity, traffic control, strategies, road side ways, vehicle safety, gadgets, speed control.**

1. INTRODUCTION

1.1 Background to the study

Abdel, Pande and Liang (2010) define proactive traffic control as part of traffic management that involves adoption and implementation of road safety strategies aimed at preventing transport safety risks. In the context of this study, proactive traffic control strategies involve practices that can be used to avert the likelihood of road safety threats. There are several of such strategies (ITF, 2008), however this study was limited to enforced use of road side ways, automobile safety requirements and preventive speed gadgets. These were perceivably part of priority traffic controls for road safety needs

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in urban areas in Kisumu County basing on previous Kenya's NTSA[1] reports (NSTA, 2015). Road safety is broadly defined by the Finnish Transport Agency (FTA, 2010) as a function of desired effects of traffic management. Such effects include a myriad of intermediate and final outcomes of road use (FTA, 2010; Madel, n.d; Olaogbebikan and Ikpechukwu, 2013), but of more interest in this study were traffic regulations compliance, basic safety, reliability, desirability of pedestrian, bicycle traffic and travel by the disables or the elderly (intermediate) as well as road injuries and deaths (final). These, according to Kenya's road safety policy (MOR[2], 2012), are the basis for best road traffic control, which partly includes proactive traffic strategies ultimately focused on prevention of road fatality (ITF[3], 2008).

The roots of contemporary road traffic control can be traced from the first formal road safety policies dating back to 17th century of road transport transformation in Britain. This followed the emergence of formal road networks that came with road safety risks. Such policies were consistently made as roads progressively evolved in Britain itself and other fast-growing societies such as the USA that pioneered modern urbanization (Bellis, 2015; Leonard, 2004). Since, road safety policies were perceived to buttress traffic control and prevention of potential risks to road safety (Leonard, 2004), in Africa, it was not realizable until the colonial and post-colonial times when modern roads were introduced (Emmenegger, 2012; Ndegwa, 2003; Njoh, 2005; Sunderland, 2012). In Kenya, road traffic safety control has evolved through successive road policies in the past 50 years of its independence (MOR, 2012) having attained her independence in 1963 (Manyara, 2016).

The country's road safety policy development has been climaxed by the 2012 integrated national transport policy (MoR 2012) and subsequent national road safety action plan (NTSA, 2015). Nonetheless, road safety in urban Kisumu County remains an illusion despite such a potentially enabling road safety policy, which according to the 2010 constitution, was fashioned to propel preventive traffic control strategies. Such strategies should have been more successful with the constitutionally entrenched devolution system of governance (Othieno, 2011) that led to the formation of 47 Counties including Kisumu County. Found in the Nyanza region of South-western Kenya, the county's urban areas especially Kisumu City is widely known to be a transportation hub (ASIRT, 2014). This cannot however justify the road safety dilemma widely reported in the county because Kisumu, as a devolved county government, enjoys a rich institutional framework that could prevent any road misuse (Infotrack East Africa, 2014; Othieno, 2011). On the contrary, the recent NTSA report on the County in recent years presents undesirable road fatality statistics as indicated in Table 1.

Table 1: ***Accidents in Kisumu County from 2013 to 2018***

Year	2013		2014		2015		2016		2017		2018		Total	
	No	VT	No	VT	No	VT	No	VT	No	VT	No	VT	**No.**	**VT**
Fatal accidents	142	169	151	175	140	165	120	155	113	145	142	165	**808**	**974**
Serious accidents	91	133	78	109	57	133	50	105	55	128	103	175	**434**	**783**
Slight accidents	25	179	18	149	21	125	13	166	27	95	37	179	**141**	**893**
Total accidents	**258**	**481**	**247**	**433**	**218**	**423**	**183**	**426**	**195**	**368**	**282**	**519**	**1383**	**2650**

Source: NTSA (2018) Legend: VT= Victim

Beside this road fatality trend in Table 1, reports also show that in the same period, Kisumu County led South Western Kenya[4] with almost 50% of road fatalities (Aoya, 2017; NTSA, 2018). DRSEAI[5] attributed such rambling road fatality to wrong road use that would otherwise be prevented by proactive traffic control (NTA, 2018). This proactive effect was before this study a mere perception or theory for lack of related evidence on urban Kisumu in previous policy reports or scholarly work. In fact, there was never distinct road safety information on urban Kisumu. It was thus timely to research on the territory.

1.2 Statement of the problem

Kenya's national road safety policy instruments present a traffic control framework fashioned to propel prevention of undesirable road safety (MoR, 2012; NTSA, 2015). Nonetheless, desired road safety targets were illusive in urban areas

[1] NTSA stands for National Transport and Safety Authority
[2] MOR abbreviates Ministry of Roads
[3] ITF is acronym for International Transport Forum
[4] South western Kenya comprises six counties, which beside Kisumu include Siaya County, Homa Bay County, Kisii County, Migori County and Nyamira County (KCG, 2013; MDP, 2013).
[5] DRSEAI which is full is a Directorate of Road Safety Enforcement and Investigation in the NTSA

of Kisumu County owing to operational gaps in what was supposed to be proactive traffic control strategies. Urban Kisumu is part of the county reported to have led in road fatalities in South Western Kenya despite its constitutional mandate to effectively steer policy actions aimed at addressing local road safety needs. This mandate is provided for under Article 6 of Kenya's recent constitution of 2010 (Aoya, 2017; KIPPRA, 2017; NTA, 2018; Othieno, 2011). This therefore presented a major public administration headache. As at the end of 2017, South Western Kenya recorded 303 deaths, and Kisumu County was leading with almost 50% compared to the rest of the region (NTSA, 2018). Motor vehicles in the county were the leading killers followed by cyclists, particularly motorcycles. Such wrong road use was, according to WHO (2018), attributable to poor preventive road traffic controls despite lack of proof in most previous road safety scholarly analysis (Amulla, 2018; Kipkosgei, 2009; Manyara, 2016; Murimi, 2013; Nyachieo, 2015; Onyango, 2018; Othieno, 2011). This study was therefore necessary to fill the research lacuna and iron out such paradoxes about the generalized county's urban.

1.3 General Objective

To examine the influence of proactive traffic control strategies on road safety in urban Kisumu, Nyanza region, the Republic of Kenya.

1.4 Specific Objectives

1. To find out how designation of road sideways influence the level of road safety in urban Kisumu, Nyanza Region.
2. To assess the effect of enforcing automobile basic safety requirements on road safety in urban Kisumu, Nyanza province.
3. To ascertain the effect of adopting safe driving regulatory mechanisms on road safety in urban Kisumu, Nyanza province.

1.5 Research hypotheses

1. Designation of road use sideways does not significantly influence road safety in urban Kisumu, Nyanza region of Kenya.
2. Enforcing automobile basic safety requirements does not significantly affect road safety in urban Kisumu.
3. Adopting safe driving regulatory mechanisms does not significantly affect road safety in the area.

2. LITERATURE REVIEW

In this section, the review of literature covered the theoretical framework, research model, conceptual framework and previous related literature.

2.1 Theoretical framework

The theoretical framework of this study revolves around the actively caring model (ACM) of the Total safety culture theory (TSCT) used to underpin the research conceptual application. The theory has reflections of previous safety theories and was largely developed by E. S. Geller in 1994. According to Geller (1994), the total safety culture is a responsibility for which all stakeholders of an entity should collectively be concerned about safety and show that in routine commitments. In the context of this study, this cultural orientation was more clearly explicated in the actively caring model. This model is one of the three theoretical insights advanced in the TSCT (Dulaand and Geller, 2007; Guldenmund, 2010; Rakowska, and Szubielska, 2013). The other insights include the behavioural approach and classic approach but the two are reactionary and thus not applicable to a proactive traffic control research. The ACM instead supports the use of behaviour and consists of showing concerns for such behaviour to prevent and reduce risks. It takes into account human states, barriers and explains who is likely to help, and pinpoints the conditions that eases helping (Geller, 1994, Rakowska, & Szubielska, 2013). The total safety culture theory underpinned this study because it integrates road user behaviour with behavioural support through the ACM, which embodies proactive traffic control and safety systems.

2.2 Research Model

2.2.1 Target Hierarchy Safety Model

The research model was adapted from the Target Hierarchy Safety Model (THSM) as the existing review for the same purpose. The THSM recommends a pyramidal analysis of the road safety management system illustrated in Figure 1.

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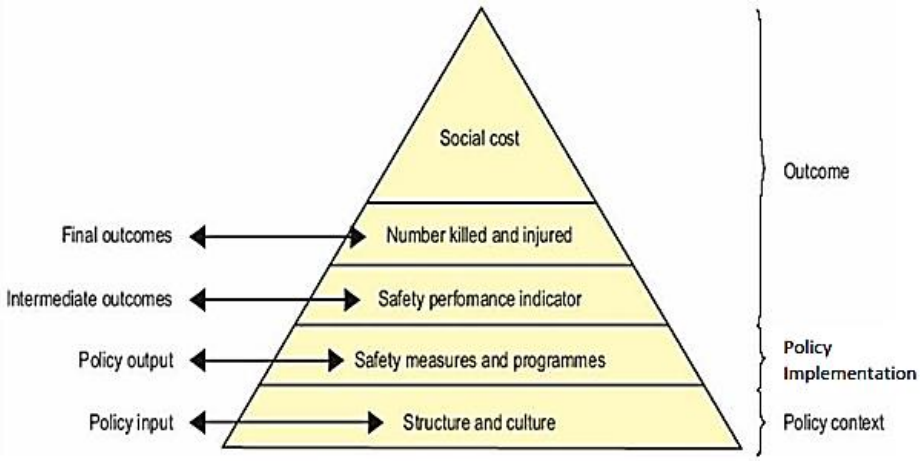

Figure 1. The target hierarchy safety model

Source: Mosink et al. (2005)

NB: The pyramid illustrates the relationship between the road safe policy, its performance and outcomes. This pyramidal conception was really useful for ideal analysis of the influence of proactive traffic control on road safety. Traffic control epitomises policy implementation while road safety embodies intermediate and final outcomes of the policy.

2.2.2 Adopted research model

This was the actual research model adapted from the THSM. It was adopted and used to direct the research process as illustrated in Figure 2.

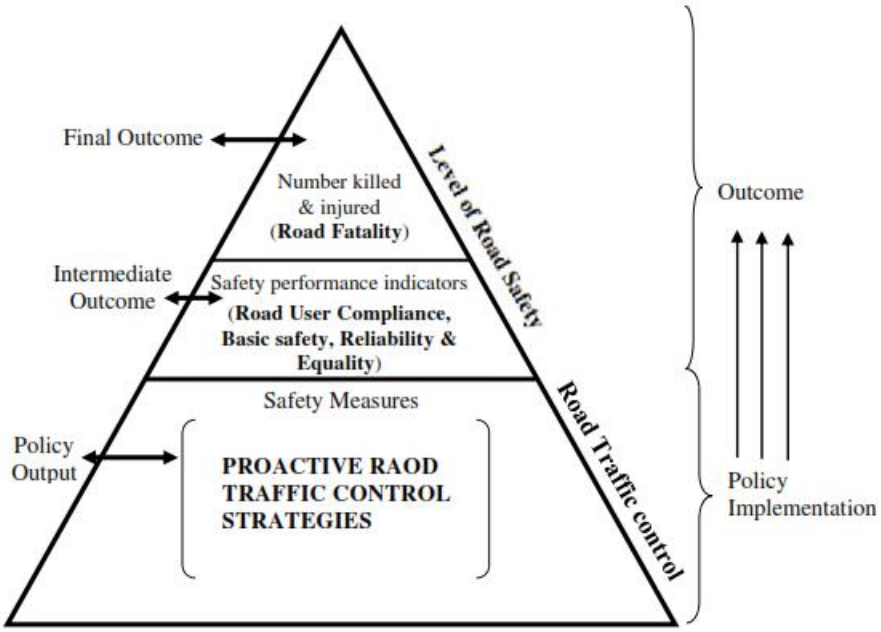

Figure 2. The actual Research Model Adopted

Source: Researcher (2018)

Unlike THMS, which starts from policy input and is abstract, the adopted model begins from policy out in an operationalized fashion. It specifically illustrates how proactive traffic control as one of the conduits of policy implementation was hypothesised to predict changes in road safety in urban Kisumu as the intermediate and final out comes of the road safety policy.

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2.2.3 Conceptual Framework

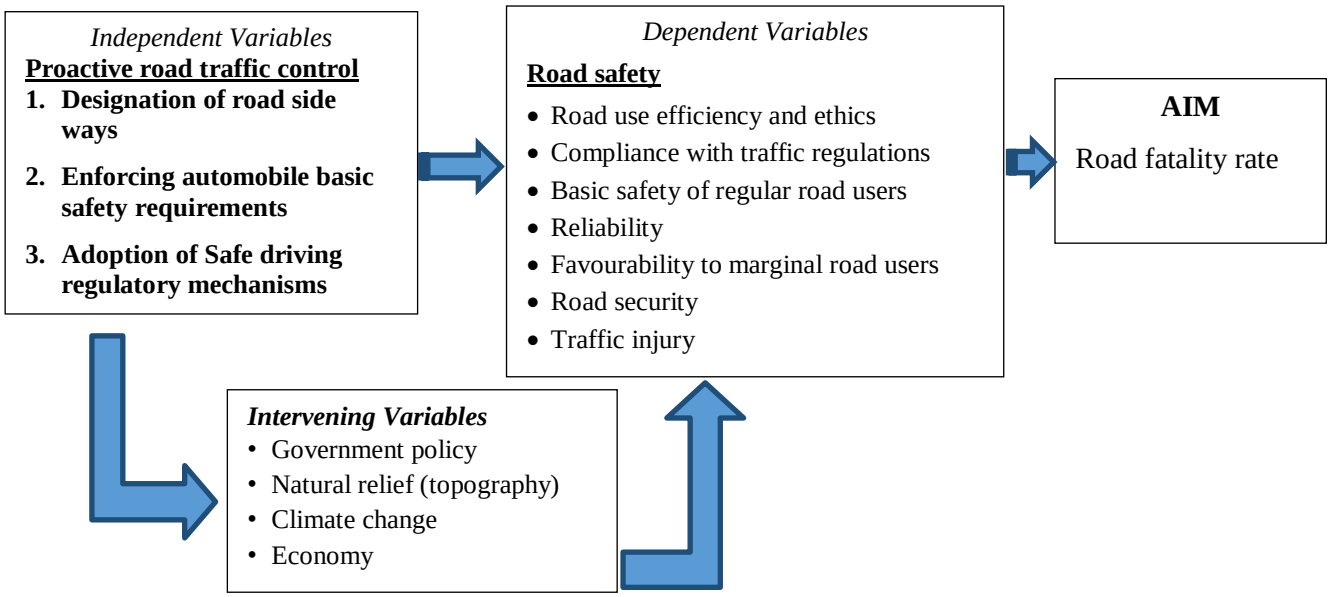

Figure 3. A conceptual framework on the influence of proactive road traffic control on road safety

Source: Adapted from ACM) of the TSCT) (Geller 1994; Rakowska, & Szubielska, 2013).

2.3 Related Literature Review

In this section, the review of related literature was made along variable associations consistent with specific objectives of the study. The variable relationships include effects of designation of road use sideways, enforcing automobile basic safety requirements, and adoption of safe driving regulatory mechanisms on road safety, respectively. Sminkey, Garwood, and Härtl (2018), in their assessment of the WHO's highlights on world road safety, report that traffic control was regarded as almost the underlying traffic management practice as it involves proactive measures in road safety promotion. They point out that existing road safety efforts in some middle- and high-income countries have mitigated the road safety situation owing to proactive traffic control strategies. Nevertheless, it was reported that this was not the same on most of the developing countries, which were perceived to be largely inclined on reaction or solutions than prevention.

In the settings where progress has been made, it is largely attributed to better legislation and timely enforcement around key risks such as speeding, drinking and driving, and failing to use seat-belts, motorcycle helmets and child restraints; safer infrastructure like sidewalks and dedicated lanes for cyclists and motorcyclists; improved vehicle standards such as those that mandate electronic stability control and advanced braking; and enhanced post-crash care (Sminkey, *et al.*, 2018). It was revealed in WHO report documents that these measures contributed to reductions in road traffic deaths in 48 middle- and high-income countries. It was reported that not a single low-income country had demonstrated a reduction in overall deaths, in large part due to their reactionary approach with similar measures, some of which were lacking such as recent and more advanced vehicle safety standards (Sminkey, *et al.*, 2018). This seemed like hearsay in some parts of the world like urban Kisumu County due to lack of specificity; not even Kenya was mentioned but rather the assessment was only generalized. There was thus need to cover the specificity research lacuna defined by contextual differences.

UNECA's (2018) review of Uganda's recent road safety experiences found out that the lack of enough commitment to preventive enforcement of traffic regulations could have compounded the problem of road fatalities and injuries faced in the country. The review reports that, although the country had a robust regulatory transport framework, several challenges compromised implementation of such policies and regulations. The review particularly discovered that the driver licensing system; training, testing and certification in Uganda needed urgent improvement. Uganda driving standards were found to be of poor quality, with driver behaviour leading to a large number of accidents. Traffic rules were well established and provided for under the Traffic Act 17 but enforcement activities were not effective enough to sustainably deter unsafe traffic behaviour such as speed, drunk driving and neglecting of seat-belt use. Challenges to implementation of traffic rules were further exacerbated by the traffic police operating with just 40% of staff. In Uganda, enforcement of such rules is primarily the mandate of the traffic police force as one of the departments of the national police service. The

review reports that such severe manpower shortage compromised effective enforcement of traffic rules (UNECA, 2018).This review presented startling picture of what traffic control can appear and cause to road safety if proper interventions are not made. However, all this only served a lesson for research on urban Kisumu because the context and macro scope of the review were different from the study area. Otherwise, there was need for the current study to fill the perceived contextual, scope and approach research gaps.

Mukabanah (2012), in his paper on Transport Reforms in Kenya, observes that the adoption of the Integrated National Transport Policy (Sessional Paper No. 2 of 2012) was a big stride but failure by government to create relevant institutions, to develop transport plans, human capacity and adopt Intelligent Transport Systems (ITS) led to unsustainable road transport management regimes. This was also the reason why so many studies done in the Ministry of Transport (MoT) were never implemented. This paper provided a significant glance on the challenges to policy implementation in Kenya but did not specifically cover road traffic control at the county level thus leaving content and contextual research gaps.

In a study on the effects of road safety regulations on passenger service vehicle operations in Nairobi, Kenya (Kipkosgei, 2009), it was found out that the regulations were generally good, however poor implementation and non- proactive enforcements hindered safety promotions. This is also reflected in Manyara's (2016) study about combating road traffic accidents in Kenya. Manyara notes that although a lot has been done on policy formulation, preventive regulation of road design and use, full and meaningful participation by stakeholders still need to be stepped up in order to address the road safety menace effectively. This was ideal but the two studies do not show the mandate of counties specifically in road traffic management thus leaving a role devolution analysis gap.

The literature reviewed above was significantly related to the current study as it revolved around preventive traffic control and road safety. Most specifically relevant to study was empirical literature because it aligns with each of the traffic control strategies preferably used to explain the level of road safety in urban areas of Kisumu County. Empirical literature review was prominently relevant as it was the basis of spotting existing research gaps in previous related literature, which warranted empirical testing. The most significant of the research gaps was the content specificity and contextual gaps.

3. METHODOLOGY

This study adopted a descriptive correlational research design based on the quantitative and qualitative approach. The descriptive design facet was adopted to answer questions of *what*, *where*, *who*, *when* and *how* (Creswell, 2007; Murphy, 2013), about each of the variables of proactive traffic control and road safety in urban Kisumu is applicable. According to Zoëga (2008), the correlational facet was used to determine co-variance between such traffic control and roads safety variables. The study assumed a quantitative approach to enhance logic and comprehensive analysis (Harwell, 2010; Neuman, 2003). The study population targeted for the research comprised several subgroups, each of which was represented by a category of the study sample adding to 365 subjects. The sample was determined using the Sloven's formula (Adanza, 2006; Altares, 2003) as well as Krejcie and Morgan's (1970) sample scale. Purposive sampling and stratified random sampling strategies were adopted to select the sample as summarized Table 2.

Table 2: Summary of the sampling procedure

Sampling	Description	Population	Sample	Instrument
Purposive sampling	Lead Field Traffic Police Officers	102	18	Structured Questionnaire (248 Copies)
Stratified random sampling	Members of the CEC	12	02	
	Members of County Assembly	45	08	
	Members of Operator Associations	48	08	
	Members of Civil Society	14	02	
	Transport Business Operators	150	26	
	Grass root Community Leaders	1050	184	
Total		1421	248	

Source: Adapted by Researcher from records of field survey institutions (2016)

The questionnaire, based on a 5-Likert Scale, was used as the instrument for collection of primary data. Responses to the 5-Likert questions or items were scaled as 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and1 = Strongly Disagree. At least 248 copies of structured questionnaire were administered among respondents as specified in Table 3.1. This was done with due diligence to respondents' informed consent and confidentiality. The collected raw data was

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presented, analyzed and interpreted using descriptive and inferential statistics based on the Scientific Package for Social Scientists (SPSS), version 16. The main descriptive statistical tools (packages) used included the arithmetic mean ($\bar{x}$), and standard deviation(S). Frequency distribution was also used in some respects. The inferential statistical tools adopted included Pearson's correlation coefficient and simple or multiple linear regressions.

For accurate interpretation of variable descriptions and covariance, interpretive scales were adopted for each of the analysis tools. The variables included road safety, road maintenance, motorcyclist training, and vehicle safety gadgets. The "scale" for the arithmetic mean ($\bar{x}$) was adapted in such a way that 1 = 'Very low', 2 = 'Low', 3 = 'Moderate', 4 = 'High', 5 = 'Very High' (Kostoulas, 2013). While scaling of the standard deviation included ≥ 1.5 = more spread from the mean and < 1.5 = closely clustered or less spread around the mean (Bland & Altman, 1996). For Pearson's correlation coefficient, the adapted scale included ≤ 0.35 = weak correlation; 0.36 - 0.67 = moderate correlation, 0.68 - 0.89 = strong correlations and ≥ 0.9 = very strong correlations (Asuero, Sayago, &Gonz´alez, 2006; Taylor, 1990).

4. FINDINGS

The study findings were collected from 233 respondents of the 248 study sample initially planned for field survey. This represented a response rate of 94%, which was far higher than the minimum 70% recommended for social science research (Fincham, 2008).

4.1 Description of the dependent variable: Level of Road safety

Seven indictors were used as constructs adopted to assess the level of Road safety in urban areas of Kisumu County, namely transport operator efficiency, interpersonal respect, observance of traffic rules and regulations, safety of regular road users, road favourability of high-risk road users, security on the roads and reduction in road use fatality. Table 3 presents descriptive statistics on the constructs adopted.

Table 3: Descriptive statistics on the level of road safety in urban areas of Kisumu County

Construct	N	Mean ($\bar{x}$)	Std. Deviation (S)
1) Efficiency of transport operators ('Reftops')	233	2.73	1.12
2) Inter transport operator respect ('Itporspct')	233	2.51	1.02
3) Compliance with traffic rules ('Rdfrscomp')	233	2.70	1.00
4) Safety of regular road users ('Saftrrusacds')	233	2.46	1.10
5) Roads Favourability to marginal users ('Frhrrusrs')	233	2.62	1.09
6) Road use poses no security threats ('Rusthr')	233	2.59	1.17
7) Reduction in road use fatality ('Rdcrfatl')	231	2.78	1.18
Grand Average Indices	233	2.63	0.80

Source: Field research (2018)

Basing on the interpretation scales adapted for descriptive statistics, results in Table 3 show that the rate of reduction in road use fatality ('Rdcrfatl') was widely relative in urban Kisumu ($\bar{x} = 2.78$; $S = 1.18$). This means, road fatality, as the final indicator of road safety, had fairly reduced in urban areas of Kisumu County. The reduction in fatality was still not enough though. As the end, such fatality rating in that part of the county justified the means, that is, discrepancy in the levels of intermediate road safety indicators also specified. Of these indicators, safety of regular road users ('Saftrrusacds') was widely rated as being poor or low at $\bar{x} = 2.46$; $S = 1.10$, and inter transport operator respect ('Itporspct') was commonly the least relative at $\bar{x} = 2.51$; $S = 1.02$ in such area of research. The rest of the indicators were also largely perceived to be moderate led by efficiency of transport operators (Reftops) at $\bar{x} = 2.73$; $S = 1.12$, followed by Compliance with traffic rules ('Rdfrscomp') at $\bar{x} = 2.70$; $S = 1.00$, then roads favourability to marginal users ('Frhrrusrs') at $\bar{x} = 2.62$; $S = 1.09$, and lastly absence of security threats ('Rusthr') at $\bar{x} = 2.59$; $S = 1.17$.

It was thus not surprising that the grand average indices ($\bar{x} = 2.63$; $S = 0.80$) specified were generated. The indices were transformed from descriptive statistics on intermediate and final indicators of road safety and suggest that generally, the level of road safety in such urban areas of the county was moderate and sufficient with dreary rates of reductions in traffic fatalities. Furthermore, the grand average road safety indices were normally distributed (0.35), implying that the statistical data involved could be confidently subjected to correlation coefficient (bivariate) and multiple linear regression (multivariate) analyses (Sweet and Grace-Martin, 2003) to verify the research hypotheses.

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4.2 Verification of Hypothesis One: Road use sideways and safety

Findings in this theme are consistent with research objective one and were used to verify the related null hypothesis. The hypothesis stated that, "Designation of Road Use Sideways does not significantly influence Road Safety in Urban Kisumu, Nyanza Region of Kenya". To clearly verify the hypothesis, the level of road sideways designation, as the implicit independent variable, was first described before inferential analysis could be made about its influence on road safety. The statistical descriptions of the variable were presented in Table 4.

Table 4: Descriptive statistics on the sufficiency of designating road use sideways

Descriptive Statistics	Indices (DgrswyfusRk)
Mean	2.39
Upper	2.53
Lower	2.25
Std. Deviation	1.09

Source: Field survey (2018)

In Table 3, statistics suggest that designation of road sideways for fragile road users was moderately rated in much of the urban Kisumu ($\bar{x}$ = 2.39; s = 1.09). That means the level of designating of such road use sideways was relative in such areas of the county.

With knowledge of the level of road safety, Pearson's correlation coefficient and simple linear regression analyses were made to determine the implications of such traffic designation on road safety outcomes in the urban Kisumu and Kenya's urban in general as indicated in Table 5.

Table 5: Correlation and Regression (Model Summary) Coefficients

CORRELATIONS		
		Level of Election Performance
Designation of road sideways	Pearson Correlation (r)	.651**
	Sig. (2-tailed) (p)	.000
	N	231
**. Correlation is significant at the 0.01 level (2-tailed).		

SIMPLE LINEAR REGRESSION			
Model	R	R Square	Adjusted R Square
1	.651[a]	.424	.421

a. Predictors: (Constant), Designation of road sideways for fragile users in Urban Kisumu County

Source: Field survey (2018)

According correlation results in Table 5, statistics $r = 0.651^{**}$; $p < 0.001$ suggest that there was a linearly significant association (H_A) between the sufficiency of designating road use sideways and level of road safety in the urban areas of Kisumu County. Simple regression results in the table show statistic $R^2 = 0.424$ which means designation of road sideways or walkways predicted 42.4% of road safety. The rest 57.6% (0.576) was predicted by other deterrent traffic control strategies. It was concluded that road sideways designation significantly influenced road safety in urban areas of Kisumu County. Null Research Hypothesis One was thus rejected.

4.3 Verification of Hypothesis Two: Automobile basic safety requirements and road safety

In this theme, results were used to verify null hypothesis Two, which presumed that, "Enforcing automobile basic safety requirements does not significantly affect road safety in urban Kisumu". The independent was also described before its effects on road safety could be determined. The descriptive findings capture the how effectively automobile basic safety requirements were enforced. The requirements included vehicle and motorcycle basic safety requirements. For vehicle basic safety, such requirements investigated included safety seat belts, side mirrors, side indicators, driving mirrors, wind screen wipers, night vision lights, and vehicle hooter. In the case of motorcycle safety, the requirements included side

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mirrors and side indicators, helmets, reflector jacket, and night vision lights. The statistics registered about enforcement of such requirement respectively were summarized in Table 6.

Table 6: Descriptive statistics on enforcement of automobile basic safety requirements ('EnfVebsrq')

Construct	N	Mean ($\bar{x}$)	Std. Deviation (S)
1) Enforcing vehicle basic safety requirements ('EnfVebsrq')	233	2.89	1.12
2) Motorcycle basic safety requirements enforced ('EnfMvbsrq')	233	2.69	1.19
Grand average indices	233	2.79	1.16

Source: Field survey (2019)

Regarding construct 1, descriptive statistics in the table above indicate that a moderate arithmetic mean ($\bar{x}$ = 2.89) and smaller standard deviation (S = 1.12) were generated. The statistics thus suggest that enforcement of vehicle basic safety requirements was fairly effective in much of urban Kisumu. About construct 2, the descriptive statistics show that a less moderate mean ($\bar{x}$ = 2.69) and small standard deviation (S= 1.19) were computed. These statistical results imply that enforcement of the motorcycle basic safety requirements investigated was less fairly effective in much of urban areas of Kisumu County.

Grand average indices transformed the two constructs in the table indicate that a moderate arithmetic mean ($\bar{x}$ = 2.76) and small standard deviation (S=0.98) were generated. The indices imply that automobile basic safety enforcement was fairly efficacious in urban areas of Kisumu County. Generally, enforcement of such basic safety was not enough. It was significantly discrepant.

Having described the efficacy of automobile basic safety enforcement, inferential tools were administered to determine its effect of on road safety. Accordingly, Pearson's correlation and Multiple Regression coefficients were computed as summarized in Table 7.

Table 7: Correlation and Regression (Model Summary) Coefficients

CORRELATIONS			
		Technology Acceptance	
Automobile basic safety enforcement	Pearson Correlation	.599**	
	Sig. (2-tailed)	.000	
	N	230	
	**. Correlation is significant at the 0.01 level (2-tailed).		
MULTIPLE LINEAR REGRESSION			
Model	R	R Square	Adjusted R Square
1	.602[a]	.362	.357

a. Predictors: (Constant), Enforcement of vehicle basic safety requirements, Enforcement of motorcycle basic safety requirements

Source: Field survey (2018)

According to variable correlations in Table 7, road safety in urban Kisumu was linearly significantly associated with enforcement of automobile basic safety requirements at $r = 0.599^{**}$; $p < 0.001$. In particular, regression statistic $R^2 = 0.943$ indicates that this kind of traffic enforcement predicted 36.2% of road safety. The rest 63.8% (0.638) was predicted by other proactive traffic controls. This deduces that enforcement of automobile basic safety requirements significantly affected the road safety in urban areas of Kisumu County. In that case, Null Research Hypothesis Two was rejected.

4.4 Verification of Hypothesis Three: Safe driving regulatory mechanisms and road safety

The null hypothesis verified in this theme assumed that "Adopting safe driving regulatory mechanisms does not significantly affect road safety in urban Kisumu". The theme specifically covers findings that describe the reliance on such mechanisms and inferential statistics about its effect on road safety. The mechanisms of study included speed gun, speed governors, road bumps and alcoblow. The descriptive statistical results generated were presented in Table 8.

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Table 8: Descriptive statistics on adopting of safe driving regulatory mechanisms in urban Kisumu

Descriptive Statistics	Indices (smus2rgvssduk)
Mean	2.87
Upper	3.01
Lower	2.74
Std. Deviation	1.05

Source: Field survey (2018)

The statistics in the Table show that a moderate average mean ($\bar{x}$) of 2.87 and smaller standard deviation (S) of 1.05 were generated. In view of these statistics, the four traffic regulation mechanisms were more fairly used in much of urban Kisumu for control of vehicles speed and safe driving. Generally, regulation of vehicle speed and safe driving was fairly sufficient in urban areas of Kisumu County. This understanding was followed by Pearson's correlation and regression tests administered to determine the effect of such safety regulation mechanisms on road safety as presented in Table 9.

Table 9: Correlation and Regression (Model Summary) Coefficients

CORRELATIONS			
		Technology Acceptance	
Adoption of safe driving regulatory mechanisms	Pearson Correlation	.578**	
	Sig. (2-tailed)	.000	
	N	231	
	**. Correlation is significant at the 0.01 level (2-tailed).		
SIMPLE LINEAR REGRESSION			
Model	R	R Square	Adjusted R Square
1	.578[a]	.334	.331

a. Predictors: (Constant), Mechanisms used to regulate vehicle speed and safe driving in Urban Kisumu

Source: Field survey (2018)

The correlation in the table above shows that at $r = 0.578^{**}$; $p < 0.001$ road safety in the areas of study was linearly significantly correlated to adoption of safe driving regulatory mechanisms. Particularly, statistic $R^2 = 0.334$ indicates that such traffic mechanisms predicted 33.4% of road safety. The rest 66.6% (0.666) was predicted by other preventive traffic control strategies. It was thus deduced that adoption of safe driving regulatory mechanisms significantly affected road safety in the urban Kisumu County. As result Null Research Hypothesis Three was rejected.

4.5 Grand Multivariate regression analysis of proactive traffic control and road safety

This section covers overall results on how preventive traffic control strategies generally predicted road safety in urban areas of Kisumu County. The results were generated using a grand multiple linear regression analysis as presented in Table 10

Table 10: Model Summary

Model	R	R Square	Adjusted R	Std. Error of the
1	.742[a]	.551	.545	.542

a. Predictors: (Constant), Designation of road sideways for fragile users, Mechanisms used to regulate vehicle speed and safe driving, Enforcement of automobile basic safety requirements in Urban Kisumu County

Source: Field survey (2018)

According to statistics in Table 10 at $R^2 = 0.551$, proactive traffic control strategies predicted 55.1% of road safety in urban areas of Kisumu County. The rest 44.9% (0.449) could be predicted by other traffic control approaches or strategies. This infers that increase in the level or efficacy of proactive traffic control propelled road safety performance, and vice versa, in urban Kisumu County.

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4.6 Proposed model of proactive road traffic control

As a result of inferential research results above, this study proposed a new road safety model dubbed, "Proactive Road Traffic Control Model (PTRCM)". The model builds on the research model adopted to guide the research process of this very study. While the research model demonstrated how proactive traffic control strategies influence intermediate road safety performance and final road safety outcomes, the proposed model presents a more specific, applied and explicit policy-outcome relationship as illustrated in Figure 4.

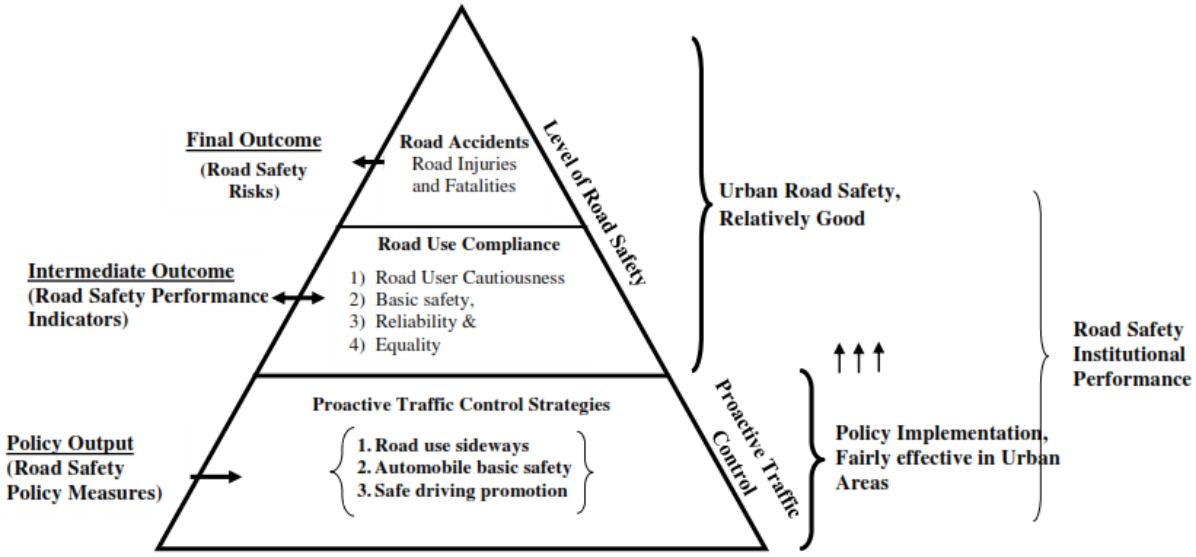

Figure 4. Proactive Road Traffic Control Model

Source: Researcher (2019)

According to the above table, the proposed model introduces an explicit fashion and a new version of road safety policy implementation that can be useful for sustainable road safety through strategies of traffic control identified. Than ever before, the strategies were well specified, investigated and used to explain the level of road safety. They include designation of road use sideways, enforcing automobile basic safety requirements, and adopting safe driving regulatory mechanisms. The model positions these traffic control strategies as reliable road safety policy measures that can be valuable for addressing any mishaps in road safety.

5. DISCUSSION OF FINDINGS

Discussion of the study findings proactive traffic control and road safety was made hypothesis by hypothesis, consistently with the research objectives. Hypothesis one assumed that Designation of road use sideways does not significantly influence road safety in urban Kisumu, Nyanza region of Kenya, but this was not true. The influence was very significant. This was verified, first by describing and second, by correlating as well as regressing the level of road safety and designation of road use sideways in urban Kisumu. In this part of Kisumu County, study findings indicate that road sideways for fragile users were relatively well designed to a few roads and were lacking along many parts of the roads including Kisumu City. Similar discrepancies were also reported by Sharma (2015) about India, as widely lacking walkways for the most vulnerable road users i.e. pedestrians and cyclists due to poor road designs. The study results show that designation of road sideways or walkways predicted 42.4% of road safety in urban Kisumu. The effect of road sideways to road safety is also, according to Sharma (2015) and Girma (2013), an issue of concern in India and most of African countries respectively. In India, the significance of such walkways led authorities to rethink in improving road designs to reduce contact between pedestrians and cyclists perceived as the host and vehicles known as the agent (Sharma, 2015).

In contrast with null hypothesis Two, reports in this study indicate that enforcement of automobile basic safety significantly affected road safety in urban Kisumu. Nonetheless, the enforcement of such traffic safety was not enough for both vehicles and motorcycles in the areas of research. Generally, enforcement of vehicle basic safety requirements of study was only fairly effective in much of urban Kisumu. the discrepant level of enforcing vehicle basic safety in urban

Kisumu corroborate what had previously been observed by Girma (2013) who reveals that this was a common practice in Africa due to lack of enough electronically detective traffic management systems and enforcement was largely dependent on manual controls, so susceptible to human behavioural dynamics. In the case of motorcycles, traffic enforcement of motorcycle safety requirements was also fairly effective. What should be undeniable though is that such enforcement was generally not enough in the urban part of the county thereby corroborating earlier concerns in Raynor (2014) about the developing world. In his paper about Boda boda cyclists in Uganda, Raynor singled out enforcement of basic safety among such commercial motorcycles as a matter over the public expressed much fear. This notwithstanding enforcement of the two automobile basic safety methods had as positively significant impact to the effect that the enforcement predicted 36.2% of road safety.

Null hypothesis three was rejected because there was a very significant relationship between the adoption of safe driving regulation mechanisms and road safety in urban Kisumu. The relationship was however moderate though significant. This, according to study reports, was because regulation of vehicle safe driving was fairly sufficient in the areas of research. Whatever the consistency of mechanisms used, vehicle speed control in urban Kisumu County was never enough to warranty highly safe driving. This locally validates Macharia's (2017) inference that regulation of vehicle over speeding in Kenya was not enough. In whichever direction, the study results suggest that such preventive traffic regulation was significant because it predicted 33.4% of road safety in urban areas of Kisumu County. This realization about vehicle speed regulation in the county corresponds to Mackey and Roodt's (2003) findings in a previous related research about South Africa.

6. CONCLUSIONS

The findings of the study not only consistently fulfill the research objectives but also led to significant lessons about the effects of proactive traffic control strategies of designating road use sideways, enforcing automobile basic safety requirements, and adopting safe driving regulatory mechanisms on road safety in urban Kisumu. As a key social responsibility in public policy and administration, road safety cannot be taken for granted. The safety levels were only moderate for both intermediate and final road use outcome in urban Kisumu that could be imagined enjoyed the urban care advantage. This according to study cannot be by default; it was according to findings attributed to corresponding performance of the three strategies of proactive traffic control.

None of the strategies was highly efficacious. Designation of road sideways for fragile users was the least efficacious followed by enforcement of automobile basic safety requirements and then adopting safe driving regulatory mechanisms in that order. All the strategies were fairly efficacious though. Each of the traffic control strategies or practices contributed to road safety depending on its efficiency and effectiveness. Less efficacious practices contributed less to road safety and vice versa.

In the traffic control system therefore, such traffic strategies will be more required when they are not enough and not because they are more important, after-all they are all vital for road safety promotion. No wonder designation of road sideways could be the most contentiously perceived in any road safety analyses in contexts similar to urban Kisumu County.

7. RECOMMENDATIONS

In view of the study findings, this study made the following recommendations:

Designate enough road sideways for fragile road users. Kenya's State Department of Infrastructure and Kisumu County Roads Department should ensure that enough sideways are well designated on all the parts and spots of roads in urban Kisumu County used as walkways by vulnerable road users. These include pedestrians, school children, the elderly and people living with disability.

Total enforcement of basic vehicle and motorcycle safety requirements

Traffic regulations enforcers such as the NTSA and Traffic Police Department should spontaneously and regularly crackdown on vehicles and motorcycles without basic safety requirements.

Proper and effective regulations of the vehicle speed.

The NTSA and Traffic Police should consistently use safe driving control mechanisms to ensure safe speed and driving among vehicle drivers in urban Kisumu County. The following mechanisms should be widely and consistently used in

every part of the county to curb vehicle over speeding: Vehicle speed regulator; Speed gun; Enforcing speed governors; Road bumps, and Alcoblow.

Further research

The study also recommended that further research should be done in the following ways to address perceived knowledge gaps: a) other traffic control factors influencing road safety, b) a comparable study in other counties of Kenya or elsewhere in the world, c) conducting the same study over ten years to come, and d) other transport subsectors can be studied.

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