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TRAFFIC INFORMATION AND ROAD SAFETY IN KISUMU COUNTY, SOUTH WESTERN KENYA

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Abstract: **This study examined the influence of road traffic information on road safety in Kisumu County, South Western Kenya. For this purpose, the study specifically assessed the influence of traffic signages, and the significance of traffic guidelines on road safety in the county. The study adopted an exploratory and descriptive correlational research design based on the quantitative and qualitative approach. The study population included 1919 people categorised in different subgroups that were used as sampling frames to select a study sample of 365 respondents for field research. The study findings indicate that the level of road safety in rural Kisumu was low and relatively high in urban Kisumu. In particular, road fatality was only less fairly reduced on rural roads and more relatively decreased on urban roads in the county. This was correspondingly attributed to discrepancies in traffic signages, and the provision of traffic guidelines that varied between the two territorial areas of the county. Particularly, traffic signages were inadequate in most of rural Kisumu and fairly sufficient in urban Kisumu. Provision of traffic guidelines was less consistent in most rural areas and fairly consistent in urban areas of the county. It was concluded that road safety in Kisumu County had a very significant bearing on the sufficiency of traffic signages as well as consistency of traffic road use guidance. Generally, Kisumu County as a whole had a lot more to do with such traffic information 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 county should collectively help bolster traffic information provision 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 and safe road use.**

Keywords: **Road traffic signages, regular traffic regulations, road traffic warnings, transport operators, marginal road users, road fatality.**

1. INTRODUCTION

1.1 Background to the study

The strategy of contemporary road traffic information dates far back to the first formal road safety policies of the 17thcentury. One of such pioneer policies was the British road safety policy of 1663 formulated to transform road transport (Bellis, 2015; Wellings, 2002). In most of Africa, modern road traffic information systems were widely introduced, much later with the advent of initial post-colonial road safety policies of early 1960s. This followed formal but uncontrolled construction of roads that had spread widely in much of colonial Africa that would latter successively achieve independence from the 1950s (Sunderland, 2012). Kenya achieved independence in 1963 and since then, her road safety management, including traffic information, has evolved through successive road safety policies. This started from the 1965 Sessional Paper No.10 drafted just after independence, to the structural adjustment era, and currently to the 2010 Constitutional epoch (Ministry of Roads, 2012). Since the recent constitutional review that introduced devolution, management of road traffic information in Kenya became a shared responsibility between the national government and county governments including Kisumu County (Othieno, 2011). Despite this long policy history, road safety particularly Kisumu County still contentiously lacked deep explanations, which according to this study, could be attributed to knowledge gaps in previous road safety research.

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Anchored on the total Safety Culture Theory (Geller, 1994), the study sought to address the perceived research gaps by investigating the consequences of traffic information. Largely developed by E. S. Geller in 1994 and later undergone successive revisions, the theory integrates behavioural values, classical principles and the actively caring model (Geller, 1994; Guldenmund, 2010; Rakowska, and Szubielska, 2013). Of much interest in this study was the actively caring model that routes for proactive steps such as traffic information to counter road safety threats (Cole, Stevens-Adams and Wenner, 2013; Marsh, 2014). In the context of this study, traffic information refers to a package of all informative systems required to enable effective and safe road use (Winder *et al.*, 2009). Some of the systems, according to FTA (2010), include road signages, and traffic guidelines. Road safety was conceptualized as a function of perceived desired road use effects of road traffic management (FTA, 2010; Olaogbebikan and Ikpechukwu, 2013)

Road safety in Kisumu County remains an illusion more especially in rural areas despite Kenya's potentially enabling road safety policy, which according to the 2010 constitution, was fashioned to propel safety promotion practices such as traffic information. Such practices would have been more realistically successful with the constitutionally entrenched devolution system of governance (Othieno, 2011) that led to 47 counties including Kisumu County. Found in Kenya's South-western region, the county is widely known to be a transportation hub linking Kenya to Uganda, North-western Tanzania, Burundi, Rwanda, Southern Sudan, and Eastern Democratic Republic of Congo (ASIRT, 2014). Yet, this should not have justified the road safety quagmire reported in the county because, as a local government, Kisumu enjoys a rich institutional framework that would have otherwise been used to closely and reliably administer the road safety policy (Infotrack East Africa, 2014; Othieno, 2011). However, Kenya's National Transport and Safety Authority (NTSA) report on Kisumu County's road safety performance in recent years presents daunting statistics on road fatality as summarised 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

Apart from this unpromising road fatality trend in the table, the report also indicates that during that period, Kisumu County was the leading in South Western Kenya with almost 50% of road fatalities (Aoya, 2017; NTSA, 2018). The region comprises six counties, which beside Kisumu include Siaya County, Homa Bay County, Kisii County, Migori County and Nyamira County (KCG, 2013; MDP, 2013). NTSA's Directorate of Road Safety Enforcement and Investigation (DRSEAI) attributed such rampant road fatality in the county to wrong road use that would otherwise be well regulated with consistent traffic information. Previous scholarly road safety research in Kenya covered road traffic information (Manyara, 2014; Kipkosgei, 2009; Manyara, 2014; Othieno, 2011), but it was short of the reliable evidence about Kisumu County. Therefore, the current study was timely.

1.2 Statement of the problem

Road safety in Kisumu County remains fragile despite the recent promulgation of the 2010 national Constitution much celebrated for its road safety policy boost (Aoya, 2017). The policy presents a sound institutional framework for road traffic information, which is supposed to enhance road use efficiency and safety (Ministry of Roads, 2012). However, eight years since, the policy target has not been adequately met in Kisumu County as road safety remains a major public administration problem (NTSA, 2018). In recent years, motor vehicles were the leading killers, with private vehicles

contributing 34%, followed by heavy commercial vehicles at 23% and PSVs 20%. The rest 27% of the road fatalities were caused by cyclists particularly motorcycles. The road safety risk in the county was high with an annual road fatality rate of 31.3 per 100 000. This compared unfavourably with national fatality estimates of 28.2 per 100 000 (ASIRT, 2014; WHO, 2016).

DRSEAI blamed road fatalities on wrong road use, as estimates showed that of 10 drivers for all motorized vehicles, 7 often drove carelessly and more than ½ of the pedestrians, three quarters of 10 motorcyclists and more than three quarters of 10 bicyclists hardly adhered to traffic regulations (ASIRT, 2014; Regional Traffic Police Service, 2015). Bhargavi and Kannaiya (2011) observe that wrong road use could be attributed to poor road traffic management practices such as traffic information. This however, had not been proven in most previous road safety scholarly analysis (Asingo and Mitullah, 2007; Chitere and Kibua, 2006; Kipkosgei, 2009; Manyara, 2014; Othieno, 2011; Wasike, 2001). Moreover, such analysis could not contextually represent Kisumu County in particular. Thus, this study was imperative to address the existing research lacuna and paradoxes about Kisumu County.

1.3 Purpose of the study

The purpose of the study was to examine the influence of traffic information on road safety in Kisumu County, South western Kenya.

1.4 Specific objectives of the study

To achieve the research purpose, the study sought to:

1. Examine the influence of traffic signages on road safety in Kisumu County of South western Kenya.
2. Determine how provision of traffic guidelines affects road safety in Kisumu County of South western Kenya.

1.5 Research hypotheses

1. There is no significant influence of traffic signages on road safety in Kisumu County in South western Kenya.
2. Provision of traffic guidelines does not significantly determine road safety in Kisumu County of South western Kenya.

2. LITERATURE REVIEW

2.1 Theoretical framework: Total safety culture theory

This study was underpinned by the Total Safety Culture Theory (TSCT). According to the theory, total safety should be a responsibility for which all stakeholders of an entity should collectively be concerned about and show that in routine commitments (Dulaand and Geller, 2007; Geller, 1994). TSCT was progressively revised and this led to three theoretical insights, namely behavioural approach, classic approach and actively caring model (Dulaand and Geller, 2007; Geller, 1994; Guldenmund, 2010; Rakowska, and Szubielska, 2013). Subsequently, the theory assumed a shift from risk-tolerant to risk averse and from reactive to proactive approach in the pursuit of safety (Cole, Stevens-Adams and Wenner, 2013; Marsh, 2014). The behavioural approach, originally adopted by E. S. Geller, the proponent of TSCT, suggests that safety culture recommends reactive actions to problems and chances encountered in an organisation or institutional set up (Geller, 1994, Westrum, 2004). The subsequent classical approach perceives safety culture theory as a proposition of shared beliefs, perception and values among stakeholders in relation to the safety.

According to Hale (2000), the classicals' safety culture is largely reactionary although there are significant insights of pro-action. The actively caring model supports the use of behaviour and consists of showing concerns for such behaviour to prevent and reduce risks (Geller, 1994, Rakowska, & Szubielska, 2013). Besides perceiving safety culture as a proactive approach, actively caring model underscores that such a culture is characterised by communication based on mutual trust, perception of the importance of security, belief in the efficiency of used safety measurements (Cole *et al*, 2013;Guledman 2010; Marsh, 2014).The total safety culture theory was used to guide this study because it provided a meaningful definition for road traffic information whose parameters illustrated in the following conceptual framework were perceived to be more of proactive than reactive in the quest for road safety.

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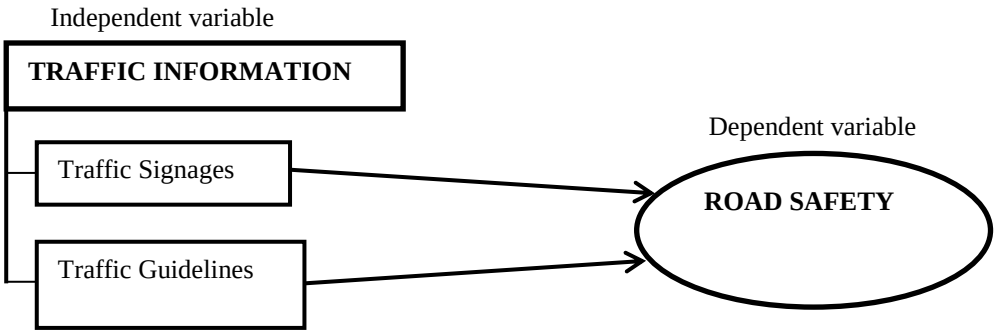
2.2 Conceptual framework



Source: Adapted from the Total safety culture theory (Geller, 1994).

Figure 1. **Conceptual framework about the influence of road traffic information on road safety**

2.3 Related literature: traffic information and road safety

Traffic information according to Arnau-Sabatés, Garcia, Muñoz & Capdevila (2013), is a critical embodiment of road user knowledge of traffic conditions and controls which in turn is fundamental for road safety promotion. In the same disposition, the following sections present reviews of empirical literature on the implications of traffic signages, and traffic guidelines, all of which were perceived as traffic information parameters that potentially predicted the level of road safety in Kisumu County.

2.3.1 Traffic signages and road safety

According to a Synthesis by the UK Department of Transport (DfT, 2013), research show that inadequate, poorly designed and maintained road signs and markings are often cited as a significant contributing factor to road traffic injuries (RTIs). Too few road signs and markings can cause driver confusion, poor traffic management and inappropriate speeding. Poorly designed and placed signs affect road safety by distracting the road user. Research also shows that over-provision of road signs and marking detract from the environment. Accordingly, too many signs and markings are thought to cause cluttering and mental overload leading to driver distraction too. In that case, DfT recommends provision of enough road signages also as necessary and appropriate quoting the example of Great Britain as a success story.

According to DfT, Great Britain is thought to have one of the safest road networks in the world owing to the quality of its traffic signs and markings which make a significant contribution. Signing and carriageway markings in the UK comply with the Traffic Signs Regulations and General Directions (TSRGD). To be effective, signs and markings were designed and implemented in a way that the messages they convey are clear, unambiguous, visible and legible. Maintenance of signs and markings is important. Whilst one of the primary objectives of road signs, signals and markings is to provide useful information to the driver so that the resulting appropriate behaviour will prevent RTIs, they also indicate legally enforceable speed regulations at specific locations. It was therefore urged that clear and efficient signing and marking should be an essential part of road traffic engineering. The DfT synthesis is a good guiding analysis but was only inspirational to the current study. It was not exhaustive, for it is not only just qualitative but is also not specific about the road signages. Also it could not represent Kisumu County that presents distinct and micro traffic management dynamics and environment.

In their analysis of sustainable road safety practices in the Netherlands, Aarts and Wegman (2010) underscored the value of traffic information. They found out that traffic information needs of road users have no boundaries. That, such needs call for, among others, good roads with all the requisite road signages. They argue that such road safety needs were useful anywhere regardless of location and territory and guaranteed road safety for all. This analysis was macroscopic and about a foreign country with a different traffic context but it set a leading precedent for the current study. It was otherwise a relevant research example which the current study sought to validate at micro level and in the context of Kisumu County.

Ezeibe *et al.* (2017) conducted a qualitative study to assess the impact of traffic sign deficit on road traffic accidents in Nigeria. They engaged 720 commercial vehicle drivers for field survey. Result shows that failure of government to provide and maintain traffic signs in order to guide road users through the numerous accident black spots on the highways was the major cause of road accidents in Nigeria. The study reports how this was regrettable because warning road users

about black spots was not so demanding compared to the routinely required education on traffic rules and guidelines; traffic risks at black spots were occasional. In light of these perceived discrepancies, Ezeibe et al. (2017) note that the government should have managed the challenge of traffic warning road signs according to best-practice which usually recommends provision and maintenance of traffic signs enough to guarantee road safety. Ezeibe et al's recommendation was admirable in relation to what transpired on Nigeria's roads. However, what happened in a micro and different context of Kisumu County was not known and thus warranting the current study**.**

2.3.2 Traffic guidelines and road safety

A retrospective and prospective review was made about road safety strategy and targets of Great Britain (McMahon, 2010). More particularly, it was realized that road safety was a human right which needed to be supported and so, the British rose to the occasion to ensure that proactive measures were adopted to empower road users control road carnage then and in the future. One of the strategies coined for that campaign was to ensure provision and adherence to traffic guidelines. For this purpose, a casualty reduction target was set for Great Britain for 1987 to generate new interest and activity in road safety. This target was to reduce all road traffic casualties by a third by 2000 compared with the average for 1981–85.

The target followed an Inter-departmental Review of Road Safety set up in 1983 in light of the concern that progress in reducing casualties appeared not so significant. Between 1981 and 1985, casualties of all severities fell from 325,000 to 318,000, with an average of 322,000 over the five-year period. At the same time, deaths in road crashes fell from 5,846 to 5,165, averaging 5,598 and killed and seriously injured (KSI) together averaged to 124,000. One of the priority concerns identified for redress through traffic information among other strategies was reducing the contribution of human road use error through consistent traffic warnings and information on basic regulations. Well, this review was motivating but could not be relied on to explain the situation in Kisumu County. It was assumed road traffic stakeholders in the county may not have similar motivation of pro-action through traffic guidelines. The current study was thus essential.

A study by Harun (2015) assessed road user's awareness on strategies for controlling road traffic accidents in Kigoma-Ujiji Municipality in Tanzania. The study was based on a combination of qualitative and quantitative methods to collect and analyse data from 100 respondents involved in the field survey. The findings show that knowledge of traffic rules varied greatly among respondents by type of road user, with vehicle drivers scoring highest and pedestrians being the least knowledgeable of all. One of the reasons given for the reported gaps in traffic awareness was that, information on traffic rules and/or guidelines was supposed to be diversified and a routine which authorities could not consistently do because it was more demanding. The study therefore recommended increasing and diversifying road user guidance, tailored to specific needs of each group as one of the key strategies of improving road safety in Ujiji Municipality and the environs in Kigoma. What could have happened in Kigoma, Tanzania could also happen in Kisumu, Kenya vis-à-vis road traffic regulation and safety. However, there was need to prove that, considering the geographical and institutional differences of the two locations, thus the need for the current study.

In Kenya, Manyara (2014) carried out a study about combating road traffic accidents in the country. The study identified traffic ignorance and less compliance to traffic rules and guidelines as antecedents of Road Traffic Accidents (TRAs), which in turn became a major cause of death and disability in the country just like around the world. It specified that over 3,000 people in Kenya died through road accidents every year, most of them between the ages of 15 and 44 years. The cost to the economy from these accidents was in excess of US$ 50 million being exclusive of the actual loss of life. The study was relevant as it linked road fatality to lack of enough consistent guidance of road users, but it is macro; it was about Kenya as a whole and thus lacks detail of the grassroots. It also did not proportionately show how consistently people were guided about road safety dynamics.

2.4 Summary

The most significant research gap in the existing empirical literature, according to the above review, was the content specificity gap. Related literature could not specifically explain the effect of road traffic signages, and traffic guidance on road safety. The theoretical review specified how useful the total safety culture theory as the underpinning theoretical framework of this study; the theory integrates binding theoretical insights relative to road traffic information and safety. The empirical literature review also presented other several research gaps including the scope research gap, in-depth analysis gap, temporal gap, approach gap, contextual research gap, locational gaps and content clarity gap among others. It was bound on these gaps that the current study claims originality and was deemed essential for policy and academic significance.

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3. METHODOLOGY

This study adopted an exploratory and descriptive correlational research design based on the quantitative approach. The exploratory facet of design was useful for ascertaining an unfamiliar research problem (Van der Mescht, 2014), while descriptive design facet was adopted to answer questions of *who*, *what*, *where*, *when* and *how* related to the research problem (Creswell, 2007; Murphy, 2013). According to Zoëga (2008), correlational facet was used to determine co-varying linkages between variables. The study assumed a quantitative approach to enhance logic and comprehensive analysis (Harwell, 2010; Neuman, 2003). The study population targeted for research comprised several subgroups each of which was represented by a category of the study sample adding to 365 subjects. The sample was determined based on Sloven's formula (Adanza, 2006; Altares, 2003) as well as Krejcie and Morgan's (1970) sample scale. It was selected using purposive sampling and stratified random sampling strategies. Refer to Table 2 for a summary of the sampling procedure.

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 2. This was done with due diligence to ethical considerations, key of which were respondents' informed consent and confidentiality. The collected raw data was presented, analysed 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). The inferential statistical tools adopted included Pearson's correlation coefficient and standard multiple regression.

For accurate interpretation of variable descriptions and covariance, interpretive scales were adopted for each of the analysis tools. The variables included road safety, traffic signages, and traffic guidelines. 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 $\geq$ 0.9 = very strong correlations (Asuero, Sayago, & Gonz´alez, 2006; Taylor, 1990).

4. FINDINGS

At a response rate of 94%, the study findings were recorded from 233 respondents of the initially targeted sample of 248 subjects. This was very sufficient to address the research problem because, according to Fincham (2008), a minimum response rate of 70% is recommendable in social science research. In this section, findings were presented, analysed and interpreted in a fashion consistent with the research objectives. For this reason, the dependent variable was described, and its association with the independent variables was analysed hypothesis by hypothesis relative with the same research

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objectives, respectively. However, this was preceded by respondents' background information, whose purpose was to verify their response potential and authenticity of the findings (Kaya, 2013; Wyse, 2012).

4.1 Background information

Findings on the background of respondents (n = 233) cover details on relevant characteristic variables as follows. In terms of gender, 58% of the respondents were male and the rest 42% were female. Regarding age, majority 67.2% of the respondents were of middle age, which according to Stern (2016) falls between 35 and 58 years, 28.8% were youths, and only 0.9% were aged 15-19 years. About their level of Education, 9.0% of the respondents had Kenya Certificate of primary education (KCPE), 39.5% were holders of Kenya Certificate of Secondary Education (KCSE), 9.9% held College Education Certificates (CEC), 24% had Diplomas, 13.7% were holders of bachelors' degrees, and the rest 3.9% had masters' degrees. Concerning their period of stay in Kisumu County, 20.6% of the respondents had operated there for not more 9 years, about 30% had stayed there for 10-19 years, and the majority 48.5% had lived in the county for over 20 years.

As regards the type of road use, 61.4% of the respondents were mostly passengers, 12.4% were drivers, 11.2% were car owners, 7.7% were road traffic regulators while the rest 7.3% had equally used all these forms of road use. In relation to their experience of road accidents in the county**,** 45.4% of the respondents had personally been involved in an accident, while 89.3% had witnessed a very close person being involved in a similar road mishap. Findings on the severity of road accidents showed that among respondents ever personally involved (n = 106), 75.4% suffered minor injuries, while 24.6% others suffered serious injuries. Of the respondents (n = 208) that had ever witnessed accidents involving very close persons, 47.6% reported minor injury, 30.9% reported serious injury, while the rest 21.5% indicated that their kin had died as a result. With all such characteristics above, respondents could be relied on for consistent information on road safety research.

4.2 Description of the dependent variable: Level of Road safety

The level of Road safety was measured along seven constructs, namely efficiency of transport operators, interpersonal respect of transport operators, 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. Road safety in Kisumu County, was separately described in terms of Rural Kisumu and Urban Kisumu because the two territories present distinct contexts with different experiences of road use (Pateman, 2011), respectively. For concision purposes, Rural Kisumu (RK) represents rural areas while Urban Kisumu (UK) represents urban areas of Kisumu County. Table 3 presents a summary pertinent descriptive statistics.

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

Construct	Territory	N	Mean ($\bar{x}$)	Std. Deviation (S)
1) Efficiency of transport operators ('Reftops')	Rural Kisumu	233	2.63	1.17
	Urban Kisumu	233	2.73	1.12
2) Inter transport operator respect ('Itporspct')	Rural Kisumu	233	2.30	1.02
	Urban Kisumu	233	2.51	1.02
3) Compliance with traffic rules ('Rdfrscomp')	Rural Kisumu	233	2.50	1.01
	Urban Kisumu	233	2.70	1.00
4) Safety of regular road users ('Saftrrusacds')	Rural Kisumu	233	2.28	1.02
	Urban Kisumu	233	2.46	1.10
5) Roads Favourability to marginal users ('Frhrrusrs')	Rural Kisumu	233	2.44	1.13
	Urban Kisumu	233	2.62	1.09
6) No road use poses no security threats ('Rusthr')	Rural Kisumu	233	2.47	1.16
	Urban Kisumu	233	2.59	1.17
7) Reduction in road use fatality ('Rdcrfatl')	Rural Kisumu	231	2.57	1.23
	Urban Kisumu	231	2.78	1.18
Grand Average Indices	Rural Kisumu	233	2.46	0.87
	Urban Kisumu	233	2.63	0.80

Source: Field research (2018)

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According to Table 3, the rate of reduction in road use fatality ('Rdcrfatl') was largely less moderate in rural Kisumu ($\bar{x}$ = 2.57; S = 1.23) and mostly moderate ($\bar{x}$ = 2.78; S = 1.18) in urban Kisumu. This means, road fatality had less relatively reduced on rural roads and a bit highly relatively reduced in Kisumu County. In either territories of the county, reduction in fatality was not enough though. This explains the discrepancy in the levels of all the other six constructs of road safety of which only efficiency of transport operators (Reftops) was moderate in both rural Kisumu ($\bar{x}$ = 2.63; S = 1.17) and urban Kisumu ($\bar{x}$ = 2.73; S = 1.12). It was lesser in the former though by an efficiency difference of $\bar{x}$ = 0.10. The rest of road safety indicators specified in the table were less sufficient in rural Kisumu; even compliance with traffic rules ('Rdfrscomp') was largely rated at only $\bar{x}$= 2.50; S = 1.01, and roads favourability to marginal users (Frhrrusrs) was rated at just $\bar{x}$ = 2.44; S = 1.13, despite the two road use needs being critical. For urban Kisumu, the table shows that similar road safety measures were not highly rated either, they were just moderate and in fact, safety of regular road users ('Saftrrusacds') was low, widely rated at just $\bar{x}$ = 2.46; S = 1.10. It was therefore not surprising, the grand average indices indicate that the level of road safety in rural Kisumu was by and large low ($\bar{x}$ = 2.46; S=0.87), while in urban Kisumu, it was largely only moderate ($\bar{x}$ = 2.63; S= 0.80). Overall, the level of road safety in Kisumu County was not sufficient with unexciting rates of reductions in traffic fatalities. For both rural and urban Kisumu, the grand average road safety indices were normally distributed (0.22 and 0.35, respectively). This implies that the indices could be confidently subjected to correlation coefficient (bivariate) and multiple linear regression (multivariate) analyses (Sweet and Grace-Martin, 2003) to verify the research hypotheses.

4.3 Verification of the hypotheses

Findings generated about traffic signages, school child traffic education, and traffic guidelines, as the three research parameters of traffic information, were used to verify null research hypotheses and virtually address the corresponding research objectives. Similarly, findings on each of the parameters were separately presented for rural and urban Kisumu, due to reasons unique to either territories, or the urban advantage, common in much of the development world (Booth, Hanmer and Lovell, 2000)

4.3.1 Hypothesis One: Traffic signages and road safety

Hypothesis one presumed that traffic signages did not significantly influence the level of road safety in Kisumu County. With the level of road safety, the sufficiency of road signages was described prior to verifying the hypothesis through correlations and the eventual regression analysis. Table 4 presents a summary of descriptive statistics on road traffic signages.

Table 4: ***Descriptive statistics about the Availability of Road traffic Signages ('avairoduses')***

Road Signage		N	Mean		Standard Deviation	
			RK	UK	RK	UK
1)	Well-marked road lanes	233	2.23	3.48	1.31	1.22
2)	Parking sign posts	233	2.04	3.17	1.23	1.29
3)	Hump signs	233	2.32	3.18	1.25	1.33
4)	Zebra Crossings	233	1.97	3.10	1.38	1.38
5)	Speed reduction signs	233	2.28	2.82	1.29	1.38
6)	Route signs	233	2.15	3.15	1.30	1.33
7)	Road gradient/ slope signs	233	2.21	2.53	1.22	1.33
8)	Children crossing signs	233	2.02	2.90	1.28	1.44
Grand Average Indices ('avairoduses')			2.15	3.04	0.98	1.03

Source: Field research (2018)

Statistics in Table 4 indicate that the road traffic signages of research in rural Kisumu rated poorly, led by Zebra Crossings at $\bar{x}$ = 1.97; S=1.38 as the least rated, up through to speed reduction signs only rated at $\bar{x}$ = 2.28; S=1.29. Overall, the grand average index ('avairoduses') recorded a low rating ($\bar{x}$ = 2.15; S=0.9); this implied that road traffic signages were largely insufficiently provided in rural areas of Kisumu County. On Urban Kisumu, statistics show that all road signages investigated in that part of the county were widely rated moderately except marked road lanes, as the only one highly rated at $\bar{x}$ = 3.48; S=1.22. Subsequently, a moderate grand average index ('avairoduses') was generated at a

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rate of $\bar{x}$ = 3.04; *S*=0.9. This meant that road signages in urban areas of Kisumu County were widely average. Neither the rural roads nor urban roads had sufficient traffic signages, though the latter were much better in the county.

Following the description road traffic signages in the county, the related null hypothesis was bivariately verified using Pearson's correlation co-efficient as depicted in Table 5.

Table 5: Bivariate Pearson's correlation coefficients on the influence of traffic signages on road safety in Kisumu County

			Level of Road Safety
Sufficiency of road traffic signages	Rural Kisumu	Pearson Correlation	.444**
		Sig. (2-tailed)	.000
		N	233
	Urban Kisumu	Pearson Correlation	.560**
		Sig. (2-tailed)	.000
		N	233

**Correlation is significant at the 0.01 level (2-tailed).

Source: Field research (2018)

In Table 5, statistic $r = 0.444^{**}$ indicates that road traffic signages in rural Kisumu positively and moderately influenced road safety. Statistic $r = 0.560^{**}$ suggests that availability of similar traffic signages in urban Kisumu was also positively and moderately influential on road safety. The *r* notation stands for correlation coefficient. At $p < 0.001$, the influence of traffic signages on road safety in either territories of Kisumu County was significantly different from zero (0). Notation *p* stands for probability value or simply the *p* -value. In that case, Null Hypothesis (*Ho*) One was rejected. This means there was a linearly significant association (H_A) between traffic signages and road safety in rural and urban Kisumu, respectively. In Kisumu County therefore, increase in road signages led to a rise in the level of road safety, and vice versa.

4.3.3 Hypothesis Two: Traffic guidelines and road safety

The hypothesis was also null and assumed that traffic guidelines did not significantly determine the level of road safety in Kisumu County in South western Kenya. Of major concern was the 'consistency' of the guidelines specifies in Table 6. Note that warnings include road user caution ahead of dangerous road scenes.

Table 6: Descriptive statistics about consistency of road use guidelines in Kisumu County

Traffic guidelines	N	Mean		Standard Deviation	
		RK	UK	RK	UK
1) Basic traffic guidelines	233	2.04	2.36	1.31	1.39
2) Road use warnings	233	2.51	3.09	1.35	1.41
Grand Indices ('cnsrdustrg')		2.27	2.72	1.15	1.22

Source: Field Research (2018)

Of the two forms of traffic guidelines in rural Kisumu, road use warnings were less moderately consistent while information on regular basic guidelines was less consistently provided to road users. Altogether, all the guidelines for rural road use were less consistent at a grand index of $\bar{x}$ = 2.27; *S*=1.15. In urban Kisumu, similarly warnings about dangerous road scenes were the only guidelines moderately consistent; higher than in rural Kisumu though. The regular road use guidelines were likewise less consistently availed. However, unlike rural roads, guidelines for urban roads in Kisumu County were generally moderately and more consistently provided as indicated by the grand index of $\bar{x}$ = 2.72; *S*=1.22. By and large, of the two traffic advisories, regular basic traffic guidelines were in both rural and urban Kisumu rarely provided compared to road use warnings against road threats, which apparently were relatively consistent. With that description, the significance of such traffic guidelines on road safety was then put to inferential analysis of Pearson's correlation coefficient as represented in Table 7.

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Table 7: Pearson's correlation coefficients about the significance of traffic guidelines on road safety in Kisumu County

			Level of Road Safety
School child traffic education	Rural Kisumu	Pearson Correlation	.420**
		Sig. (2-tailed)	.000
		N	233
	Urban Kisumu	Pearson Correlation	.447**
		Sig. (2-tailed)	.000
		N	233

**Correlation is significant at the 0.01 level (2-tailed).

Source: Field research (2018)

The result on rural Kisumu (Table 7) is that, with statistic $r = 0.420^{**}$, traffic guidelines had a positive and moderate significance on road safety. About urban Kisumu, the result in the same table indicates that at $r = 0.447^{**}$, similar traffic guidelines also had a positive and moderate significance on road safety. In either territory, the importance of such guidelines at $p < 0.001$ was significantly different from zero (0). There was therefore a linearly significant connection (H_A) between consistency traffic guidelines and level of road safety in rural and urban Kisumu. So, Null Hypothesis (*Ho*) Two was rejected. In Kisumu County, the more provision of traffic guidelines was consistent the more levels of road safety increased, and vice versa.

4.3.4 Multivariate analysis: traffic signages, traffic guidelines and road safety

Multiple regression analysis was adopted not only to generate more accurate results also to reliably determine each of the parameter of traffic information under review predicted road safety levels in rural and urban Kisumu. The parameters included traffic signages, school child traffic education, traffic guidelines. The results were summarised in Table 8.

Table 8: ***Regression statistics on traffic information in rural and urban Kisumu***

Mode l	Territory	Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound
(Constant)	RK	1.24	.126		9.77	.000	.99	1.49
	UK	1.067	.135		7.879	.000	.800	1.334
Road signages provided	RK	.133	.063	.147	2.10	.037	.01	.26
	UK	.226	.054	.291	4.161	.000	.119	.333
Traffic guidance info	RK	.091	.051	.121	1.79	.045	-.01	.19
	UK	.108	.041	.162	2.632	.009	.027	.189

a. Predictors: (Constant), Road signages, Traffic guidelines.

b. Dependent Variable: Level of Road Safety in Rural and urban Kisumu

Source: Field research (2018)

The statistics in Table 8, were generated by applying the multiple regression equation adopted for this study; ($Y= \beta o+ \beta_1X_1+ \beta_2X_2+ \varepsilon$). The statistics indicate the extent to which each of the parameters of traffic information (independent variables) of study predicted a change in road safety (dependent variable). For rural Kisumu, a unit increase in road signage led to 0.133 and provision of traffic guidelines led to 0.091 increase in road safety, respectively. Beside this prediction, the need for each of the three parameters was further verified through standardized coefficients (Beta statistics), of which road signages (0.147) were the most important factor, followed by traffic guidelines (0.121) as regards road safety. At 95% level of confidence and 0.05 level of significance, the contributions of road signages ($p = 0.037$) and traffic guidelines ($p= 0.045$) were significant.

About urban Kisumu, a unit increase in road signages led to 0.226 and traffic guidelines led to 0.108 increase in road safety, respectively. Similarly, Beta statistics show that road signages (0.291) were the most important factor, followed by traffic guidance info (0.162). At 5% level of significance and 95% level of confidence, all the two parameters (factors) of urban traffic information were significant; the first recording $p = 0.000$, and the latter being $p = 0.009$. In Kisumu County, road signages compromised road safety more than traffic guidelines.

5. DISCUSSION OF FINDINGS

The study findings about traffic information and road safety were discussed hypothesis by hypothesis in a fashion consistent with the research objectives. The following sections were therefore crafted for this purpose.

5.1.1 Traffic signages and road safety

Contrary to the related null hypothesis, study found out that traffic signages in Kisumu County had a linearly positive association with road safety. In both rural and urban Kisumu, increase in road signages led to a rise in the level of road safety, and vice versa. The signages under review included road lane marking, children crossing, parking, hump, road gradient, zebra crossing, speed reduction and route signs. The above traffic association corroborates Arnau-Sabatés *et al.* (2013), according to whom such signages are a pertinent determinant of road safety. In particular the level of road safety was not enough in Kisumu County partly because of discrepancies in road signages. This contextual inference was consistently defined by the varying related experiences between rural and urban areas; traffic signages were largely inadequate in most of rural Kisumu and fairly sufficient in urban areas of the county. Even in Urban Kisumu, it was not enough yet, according to McMahon (2010), it should have been sufficient either way! This territorial differential contrasts Aarts and Wegman's (2010) recommendation for equality of territorial road safety controls; they argue that road fatality is not limited to specific lives and/or locations.

Specifically, the implications of road traffic signages in Kisumu County were mirrored from the availability of each the signages investigated in rural and urban Kisumu. In rural Kisumu, key signages were significantly not sufficient; zebra crossings were the least noticed of the signages of study, followed by children crossing signs, then parking signs, route signs, road gradient signs, road lane markings, speed reduction signs and hump signs. In the case of urban Kisumu, the most noticed was road lane marks, then hump signs, followed by parking signs, route signs, **zebra** crossings, children crossing signs, speed reduction signs, and road gradient signs. These signage variations were not necessary according to the UK Department of Transport (2013), and the sufficiency gaps of individual signages were a breach of best practice recommended in Ezeibe *et al.* (2017). It was specifically deduced that road safety was low in rural Kisumu partly due to high discrepancies of traffic signages, and moderate in urban Kisumu because of relative inconsistencies in similar signages. Though at a micro level, this study result upheld an earlier finding in Manyara, (2014) about Kenya's road fatality, death and economic costs.

5.1.2 Traffic guidelines and road safety

The guidelines reflected in the related null hypothesis included regular traffic regulations, and warnings about dangerous traffic spots, which according to findings equally account for the level of road safety in Kisumu County. Discussion of this finding was made in tandem with research objective Two. The findings show that such information on such guidelines was rarely provided in rural areas and less moderately conveyed in urban areas of Kisumu County. Of the two informative advisories, basic traffic guidelines were in both rural and urban Kisumu rarely provided compared to road use warning against likely road threats, which apparently was relatively consistent. This was contrary Bhargavi and Kannaiya (2011), whose report on India's Tamilnad indicated that such traffic guidance was vigorously provided to curtail losses of life and resources from road accidents.

Results used to verify the hypothesis indicate that the two traffic instructions, altogether, were significantly linearly related to road safety in both rural and urban areas of Kisumu County. It was however, recorded that the consistency of such guidelines constrained road safety in rural Kisumu, but was significantly enabling in urban Kisumu, despite the need for improvement. In particular, a unit increase in these traffic guidelines predicted 0.091 increase in road safety in rural Kisumu, and 0.108 increase in urban Kisumu. Besides, provision of such guidelines contributed a 0.091 change in the road safety in rural Kisumu, and 0.108 in urban Kisumu. Although this was not enough in either of the territories in Kisumu County, the effect on road safety was significant enough to disprove the research hypothesis. Discrepancies in traffic guidelines were reflective of Manyara's (2014) research, in which significant improvements were recommended.

5.2 Conclusions

It was not conceivable to attain desirable road safety in Kisumu County without sufficient provision of road traffic information. Road safety was not enough in the county and varied between territories. It was low in rural and relative in urban areas. It was fairly sufficient only in Kisumu City. Particularly, road fatality, which happened to be significant in the county, was higher in rural than urban Kisumu. Such territorial road safety discrepancies occurred depending on varying availability of traffic information. According to the study, the traffic information analysis was found out to be significant for road safety in the county included road traffic signages, traffic education of school children and provision of traffic guidelines. The three factors were the defining parameters specified in the research objectives, and in practice, a responsibility of Kenya's Ministry of Transport and Infrastructure (MTI), Kisumu County Government (KCG), National Transport and Safety Authority (NTSA) and Traffic Police department.

Road signages were inadequate in most rural areas and relatively sufficient in urban areas of Kisumu County. Even in urban Kisumu, they were not enough though. This was realised upon examining various signages perceived contentious in the County. Of these, the only sufficiently available were well-marked urban road lanes and the most required were zebra crossings on rural roads, and road slope signs on urban roads. Similarly, provision of traffic guidelines was not enough either, particularly in rural areas; the two road traffic advisories; traffic warnings and regular traffic regulations were much less provided in rural areas and moderately availed in urban areas of the county.

The discrepancy in the two traffic information factors of study was very undesirable because they were potentially significant for better road safety in both rural and urban areas of Kisumu County. In that case, much should have been done. Road signages were the most required followed traffic guidelines for improved road safety in the county as a whole. Similar road safety needs were highly likely in the rest of Kenya due to contextual similarities with Kisumu County. Therefore, road safety institutions in the country had a lot to do and correct road safety gap, more particularly in rural areas.

5.3 Recommendations

As a result of the road traffic information needs prevalent in Kisumu County, the following recommendations were made bearing in mind the specific objectives of the study.

5.3.1 Improved road signages: The National Government, through the Ministry of Transport, Infrastructure, Housing & Ubarn Development, State Departments for Transport and Infrastructure, as well as Kisumu County Government should increase on the quantity and quality of key road signages in Kisumu County.

5.3.2 Regular information on basic traffic regulations: Relevant government agencies, such as the NTSA, and County Transport and Roads Department should consistently avail road use regulations to all road users in Kisumu County, irrespective of location. TV and Radio media as well as newspapers can be used regularly for this reason.

5.3.3 Consistent and clarity of road use warnings. Regular traffic management agencies such as Traffic Police and NTSA should ensure that warnings are consistently and promptly provided to road users about any spots of danger on the roads in the county.

5.4 Future research: In future, research should be done but not limited about the following: Other traffic management practices influencing road safety; other counties of Kenya or elsewhere in the world; the same subject in the far future and other transport subsectors.

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