Evaluation of Occupational Safety and Health Practices by LPG Cylinder Retailers in Kiambu County, Kenya.

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Abstract- The study aimed at examining the current OSH practices by Lpg cylinder retailers in Kiambu County. Stratified purposive sampling was employed; raw data collected through observation, use of interview schedules, and analyzed using SPSS ver.25. It was established that 71% of the respondents did not employ safe OSH practices in their operations. The association of cylinder handling and education level of the respondents was statistically significant at 95% confidence level with X^2 (df=2) =14.193, since p=<.001. It was ascertained that 29.2% and 46.7% of the 13kg and 6kg cylinders respectively were non-conforming regarding weight measurements and non-destructive testing. Ignorance and lack of training and sensitization on Lpg safety were key challenges hindering application of good OSH practices. The study recommends routine inspections and compliance monitoring, by EPRA, in all Lpg retail centers. Moreover, engineering breakthroughs should be sought after in Lpg cylinder safety advancement.

Index Terms- Lpg cylinder safety, OSH , Retailers, EPRA

I. Introduction

Liquefied petroleum gas (Lpg) cylinder retailers face the risk of serious injury or death while undertaking the retailing activities. The risk may also spill over to consumers. There is, therefore, a need for providing simple, practical advice on eliminating /reducing the risks associated with retailing of Lpg in cylinders. For this to be effectuated, the situation on the ground must be well understood. This then necessitated a study on the current occupational safety and health (OSH) practices, and challenges Impeding the application of good OSH practices in this trade, with an overall aim of promoting a positive safety culture.

II. Materials and Methods

2.1. Study design

The study employed descriptive and diagnostic research designs. Descriptive research studies are concerned with describing the characteristics of an individual or group: This was employed to capture and describe the various OSH practices by the lpg cylinder retailers at their workplaces. Diagnostic research studies determine the frequency with which something occurs or its association with something else. (Kothari, 2004). This was employed during the lpg cylinder measurements and non-destructive cylinder testing.

2.2. Study area and population

The study area was Kiambu County, one of the 47 counties in the Republic of Kenya. It is in the central region and covers a total area of 2,543.5 Km^2. (County Government of Kiambu, 2015). The county has various urban centres namely: Thika, Juja, Ruiru Gatundu, Kiambu, Kikuyu, Karuri, and Limuru towns. (Kiambu County annual development plan, 2017). The study population comprised of 400 Lpg cylinder retailers undertaking the Lpg cylinder retail business, sampled from the selected study sites during the data collection period. (November, 2018 to February, 2019).

2.3 Sampling method

Stratified purposive sampling was employed. Thika, Limuru, and Kiambu towns were purposively selected from the population strata. The study sites were arrived at after taking into consideration the budget, time, personnel, and other resource limitations.

2.4 Sample size determination

Using the population in 2.2 above, the sample size was determined using the Barlett et al. sample size determination table. With the data being categorical, a selected margin of error of 0.05, a standard variate value of 1.96 at 95% confidence level and a recommended population proportion of 0.50; the sample size determination table gives the sample size to use for the given population of 200 retailers in Thika town, 100 retailers in Kiambu town and 100 retailers in Limuru town to be 132, 80 and 80 respectively. (Bartlett et al., 2001)

2.5. Research instruments

The measurement tools designed to obtain data from the research subjects were observation and interview schedules. Measurements and non-destructive tests were also undertaken where applicable.

2.6. Pilot testing

A pre-test was carried out in Kenyatta Road, to measure the validity and reliability of the research instruments. The pre-test targeted a sample size of 5 respondents in which all of them responded to the research instruments.

2.7. Data processing and analysis

Raw data from the field was coded, classified, checked for errors, and summarised. Thereupon, the data was analyzed using SPSS version 25, and Microsoft excel version 2019. Results of data analysis were organized and presented in the form of tables, pie charts, and bar graphs.

2.8 Ethical consideration

Respondents in the study had detailed information about the aim and objectives of the study. Permission to carry out the study was first sought from the university, then respondents in the select study sites. Confidentiality of the respondents was protected in that no names or personal information was required in the applicable research instrument, and no coercion or undue influence was exercised.

III. RESULTS AND DISCUSSION

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3.1 Current Occupational safety and health practices

The observations were made under natural conditions and findings presented below. Details of the cylinder brand owners and respondents were withheld for the protection of the dignity of the subjects, respect for anonymity, and confidentiality.

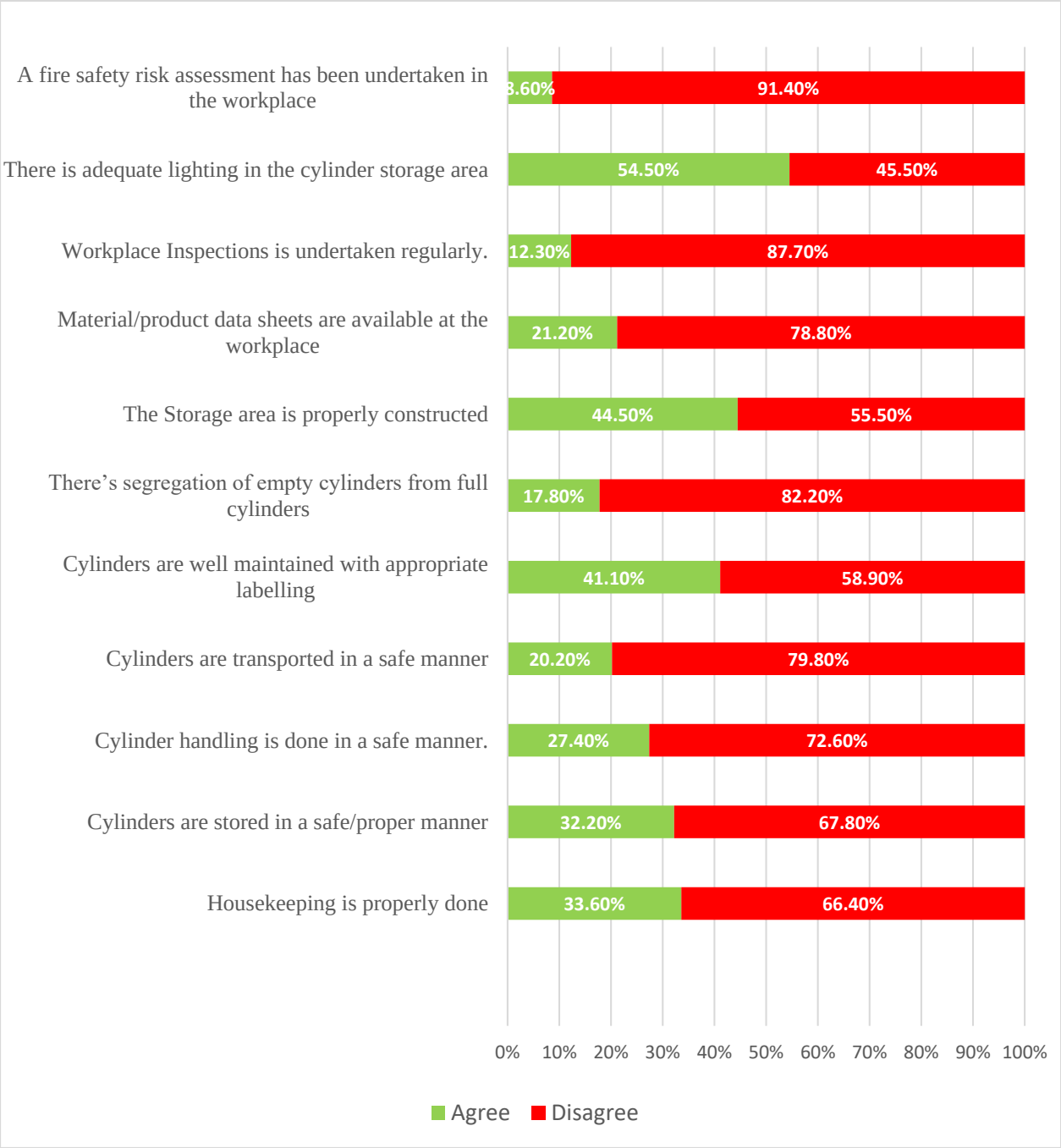

Figure 1: Current occupational safety and health practices in LPG cylinder retail business

Table 1: Association between respondents' demographics and housekeeping.

Variable	Category	Housekeeping properly done.		
		No	Yes	Chi-Square
Gender	Male	69%	31%	X^2=3.816 , df=1 , p=.051
	Female	55%	45%	
Age	18-30 years	68%	32%	
	31-40 years	71%	29%	X^2=7.268, df=2, p=.026
	> 40 years	49%	51%	
Education level	primary	66%	34%	
	Secondary	63%	37%	X^2=3.479 , df=2 , p=.176
	Tertiary	75%	25%	
Lpg retailing experience	< 5 years	74%	26%	
	6-10 years	59%	41%	X^2=17.303 , df=2 , p=<.001
	> 10 years	66%	34%	

Table 2: Association between respondents' demographics and cylinder storage.

Variable	Category	Cylinder storage in a safe manner		
		No	Yes	Chi-Square
Gender	Male	67%	33%	X^2=0.107 , df=1 , p=.744
	Female	70%	30%	
Age	18-30 years	64%	36%	
	31-40 years	78%	22%	X^2=16.755 , df=2, p=<.001
	> 40 years	47%	53%	
Education level	primary	66%	34%	
	Secondary	66%	34%	X^2=1.543 , df=2 , p=.462
	Tertiary	74%	26%	
Lpg retailing experience	< 5 years	79%	21%	
	6-10 years	51%	49%	X^2=27.110 , df=2 , p=<.001
	> 10 years	48%	52%	

Table 3: Association between respondents' demographics and cylinder handling.

Variable	Category	Cylinder handling in a safe manner		
		No	Yes	Chi-Square
Gender	Male	69%	31%	X^2=7.731 , df=1 , p=.005
	Female	88%	12%	
Age	18-30 years	59%	41%	
	31-40 years	81%	19%	X^2=17.471, df=2, p=<.001
	> 40 years	84%	16%	
Education level	primary	58%	42%	
	Secondary	74%	26%	X^2=14.193 , df=2 , p=.001
	Tertiary	86%	14%	
Lpg retailing experience	< 5 years	81%	19%	
	6-10 years	56%	44%	X^2=19.459 , df=2 , p=<.001
	> 10 years	76%	24%	

Table 4: Association between respondents' demographics and cylinder transportation.

Variable	Category	Cylinders transported in a safe manner		
		No	Yes	Chi-Square
Gender	Male	77%	23%	X^2=5.465 , df=1 , p=.019
	Female	91%	9%	
Age	18-30 years	79%	21%	
	31-40 years	80%	20%	X^2=0.100, df=2, p=.951
	> 40 years	81%	19%	
Education level	primary	80%	20%	
	Secondary	73%	27%	X^2=13.110 , df=2 , p=.001
	Tertiary	94%	6%	
Lpg retailing experience	< 5 years	89%	11%	
	6-10 years	66%	34%	X^2=23.685 , df=2 , p=<.001
	> 10 years	67%	33%	

3.2 Cylinder Branding

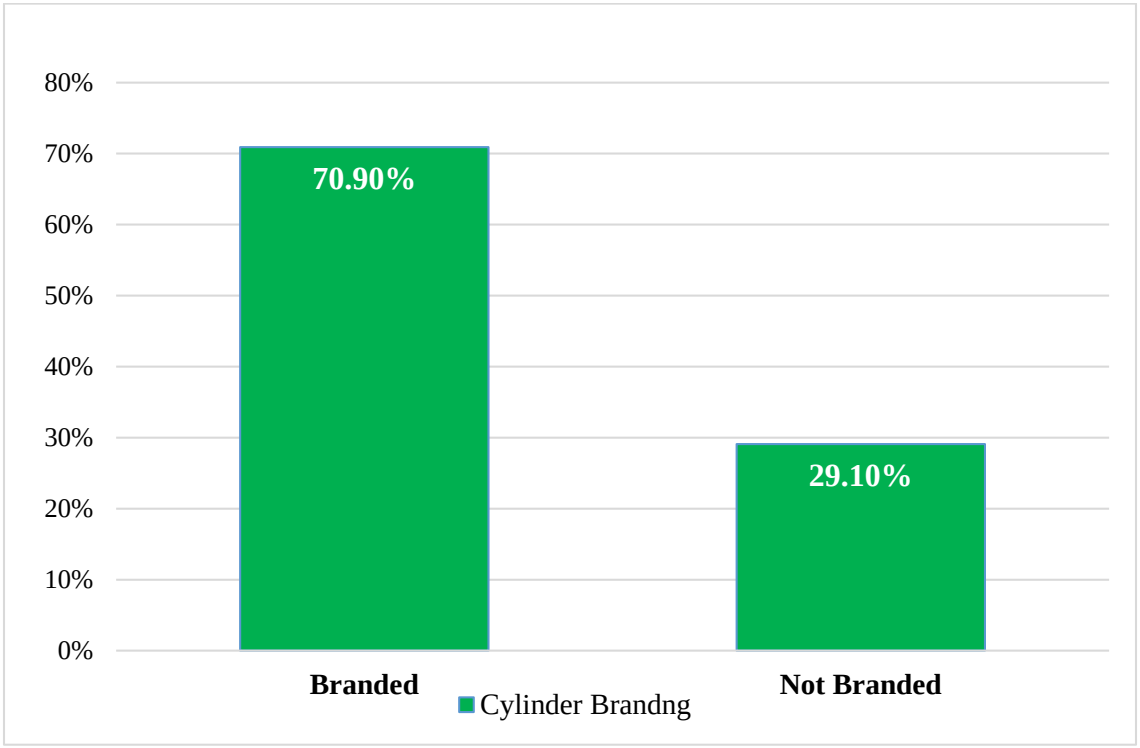

Figure 2: Cylinder branding

Unbranded Lpg cylinders may be a likely indication of illegal gas filling as no registered brand owner will circulate their gas in the market in an unbranded cylinder.

3.3 EPRA Licensing

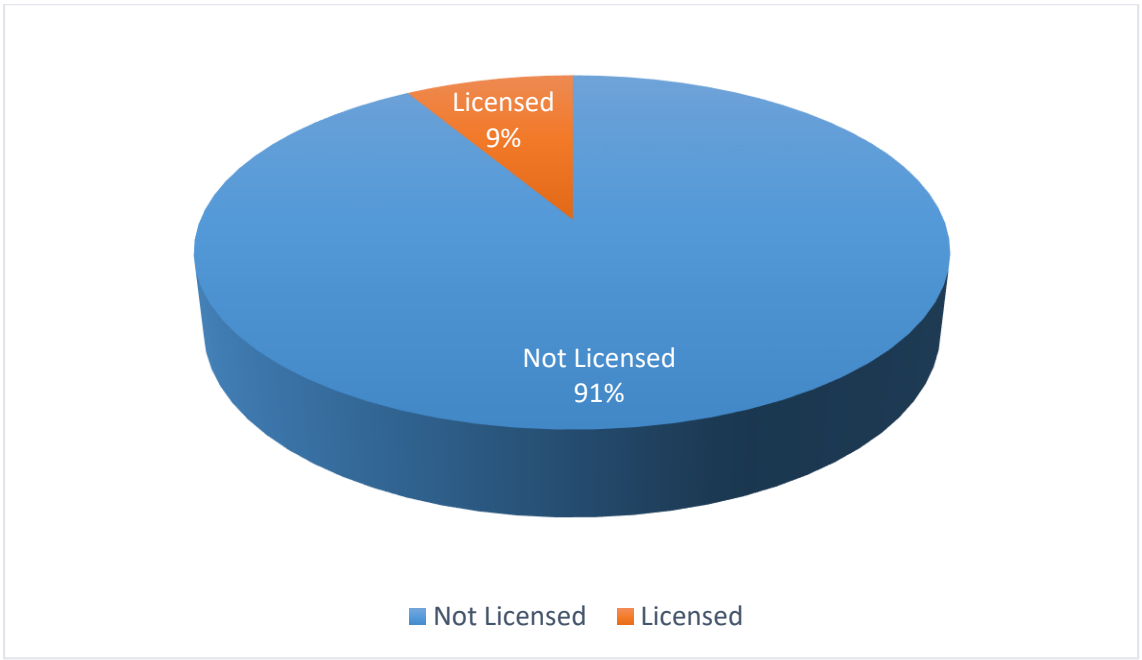

Figure 3: EPRA Licensing

3.4 Lpg cylinder filling and Non-destructive testing

Table 5: 6Kg cylinder weight measurements and leak test.

Cylinder Code	Site	Tare Weight (Kg)	Measured Gross Weight (Kg)	Lpg Weight (Kg)	Leak test		Conforms	Reason
					Leak	No leak		
6C1	T1	8.6	14.9	6.3	No	Yes	No	OF
6C2	T2	7.8	14.0	6.2	No	Yes	Yes	N/A
6C3	T3	8.0	14.1	6.1	No	Yes	Yes	N/A
6C4	T4	8.5	14.8	6.3	No	Yes	No	OF
6C5	T5	8.0	14.3	6.3	No	Yes	No	OF
6C6	T6	8.4	14.6	6.2	No	Yes	Yes	OF
6C7	T7	8.3	14.7	6.4	No	Yes	No	OF
6C8	T8	8.0	14.1	6.1	Yes	No	No	L
6C9	T9	8.3	14.1	5.8	No	Yes	Yes	N/A
6C10	T10	8.2	14.0	5.8	No	Yes	Yes	N/A
6C11	T11	8.1	13.8	5.7	No	Yes	No	UF
6C12	T12	8.5	14.6	6.1	No	Yes	Yes	N/A
6C13	T13	8.6	14.6	6.0	No	Yes	Yes	N/A
6C14	T14	9.2	15.4	6.2	No	Yes	Yes	N/A
6C15	T15	8.5	14.4	5.9	No	Yes	Yes	N/A
6C16	J1	8.5	14.1	5.6	No	Yes	No	UF
6C17	J2	8.7	13.9	5.2	Yes	No	No	L/UF
6C18	J3	8.5	13.9	5.4	Yes	No	No	L/UF
6C19	J4	8.2	13.8	5.6	No	Yes	No	UF
6C20	J5	8.9	14.8	5.9	No	Yes	Yes	N/A
6C21	J6	8.0	14.2	6.2	No	Yes	Yes	N/A
6C22	J7	8.2	14.5	6.3	No	Yes	No	OF
6C23	J8	8.7	14.8	6.1	Yes	No	No	L
6C24	J9	8.3	14.3	6.0	No	Yes	Yes	N/A
6C25	J10	8.0	14.4	6.4	No	Yes	No	OF
6C26	J11	8.5	14.7	6.2	No	Yes	Yes	N/A
6C27	J12	8.7	13.8	5.1	Yes	No	No	L
6C28	J13	9.2	15.0	5.8	No	Yes	Yes	N/A
6C29	J14	8.4	14.6	6.2	No	Yes	Yes	N/A
6C30	J15	8.3	14.2	5.9	No	Yes	Yes	N/A
Mean		**8.4**	**14.4**	**6.0**				
SD		**0.33415**	**0.3995**	**0.33235**				

Table 6: 13Kg cylinder weight measurements and leak test.

Cylinder Code	Site	Tare Weight (Kg)	Measured Gross Weight (Kg)	Lpg Weight (Kg)	Leak test		Conforms	Reason
					Leak	No leak		
13C1	T1	18.0	30.8	12.8	No	Yes	Yes	N/A
13C2	T2	12.8	25.5	12.7	No	Yes	No	UF
13C3	T3	11.9	24.8	12.9	No	Yes	Yes	N/A
13C4	T4	12.7	25.7	13.0	No	Yes	Yes	N/A
13C5	T5	13.5	26.7	13.2	No	Yes	Yes	N/A
13C6	T6	13.0	26.2	13.2	No	Yes	Yes	N/A
13C7	T7	11.9	25.1	13.2	No	Yes	Yes	N/A
13C8	T8	12.0	25.4	13.4	Yes	No	No	L
13C9	T9	12.5	25.4	12.9	No	Yes	Yes	N/A
13C10	T10	12.9	26.0	13.1	No	Yes	Yes	N/A
13C11	T11	11.9	24.7	12.8	No	Yes	Yes	N/A
13C12	T12	13.4	26.4	13.0	No	Yes	Yes	N/A
13C13	J1	13.0	26.1	13.1	No	Yes	Yes	N/A
13C14	J2	12.7	25.4	12.7	No	Yes	No	UF
13C15	J3	13.9	26.7	12.8	No	Yes	Yes	N/A
13C16	J4	14.0	26.6	12.6	No	Yes	No	UF
13C17	J5	12.7	26.0	13.3	Yes	No	No	L
13C18	J6	11.3	23.8	12.5	No	Yes	Yes	N/A
13C19	J7	12.0	24.6	12.6	No	Yes	No	UF
13C20	J8	12.1	24.9	12.8	No	Yes	Yes	N/A
13C21	J9	12.2	25.1	12.9	No	Yes	Yes	N/A
13C22	J10	14.3	27.5	13.2	No	Yes	Yes	N/A
13C23	J11	13.5	26.7	13.2	No	Yes	Yes	N/A
13C24	J12	11.9	25.0	13.1	No	Yes	Yes	N/A
Mean		**12.9**	**25.9**	**13.0**				
SD		**1.30319**	**1.32539**	**0.23965**				

LEGEND

N/A Not Applicable

UF Underfilled

L Leakage

OF Overfilled

Tolerance: +-0.2Kg.

3.5 Overall Lpg cylinder conformity Based on Measurements and Non-destructive tests

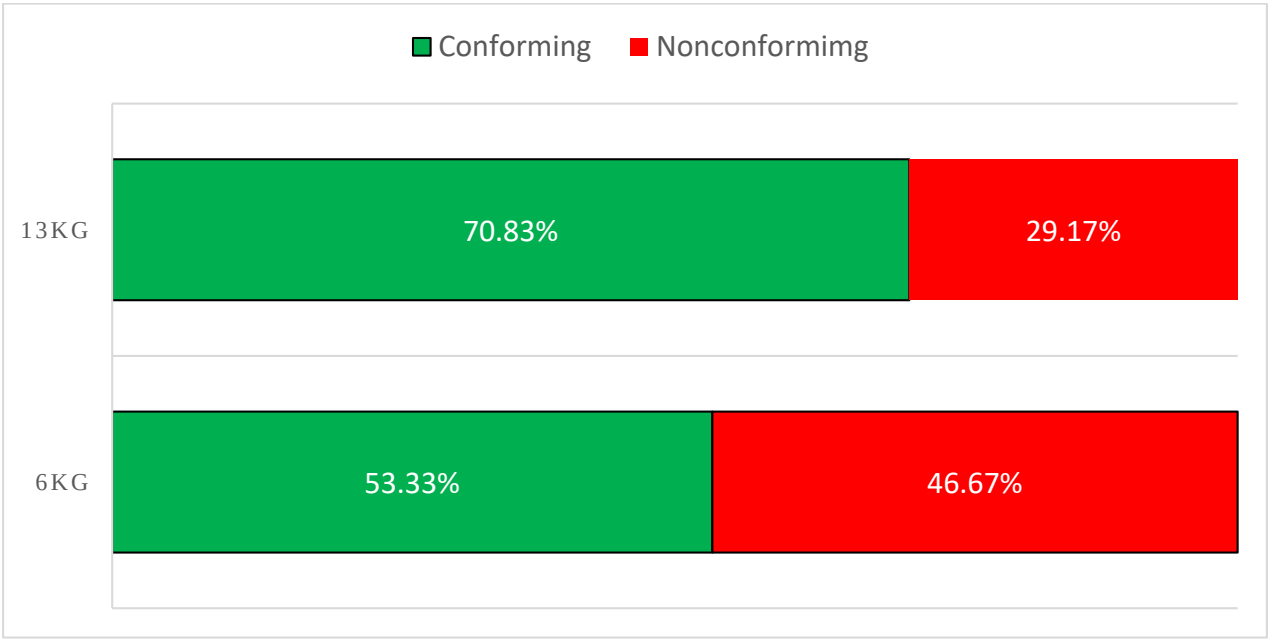

Figure 4: Overall Lpg cylinder conformity

3.6 Challenges to good occupational safety and health practices

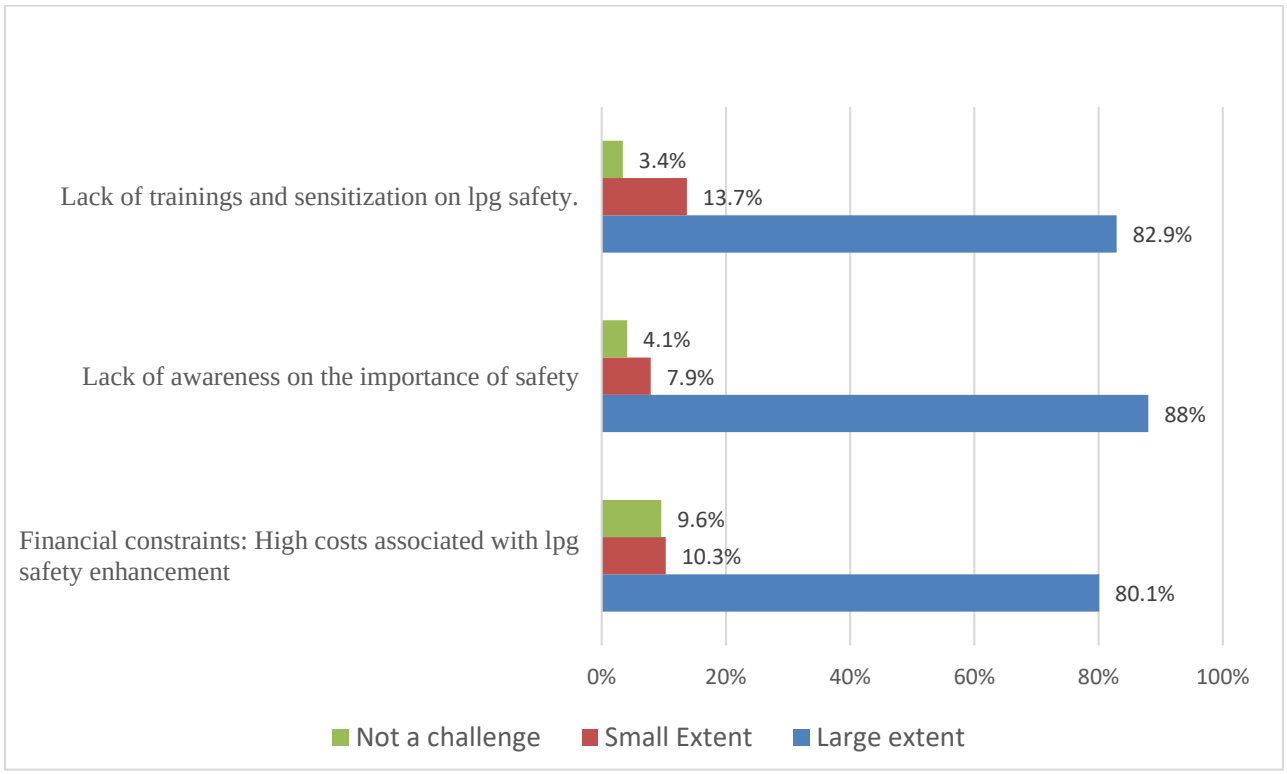

Figure 5: Challenges to good occupational safety and health practices

IV. Discussion and conclusion

The study established that 71% of the Lpg cylinder retailers do not employ safe occupational safety and health practices in their Lpg retail operations-very worrying indeed-. At the same time, 16.7% of the 6Kg cylinders were found to be leaking from the valve. Leakages from the valve area maybe a likely indication of tampering with the valves during illegal gas refilling. 40% of the 6Kg cylinders were not conforming with regards to cylinder filling. Additionally, 8.3% of the 13Kg cylinders were as well found to be leaking from the valve. Similarly, 12.5% of the 13Kg cylinders were not conforming with respect to cylinder filling.

Overfilling of cylinders is unlikely to be done deliberately and a likely indication of faulty or poorly calibrated filling equipment. Underfilling of Lpg cylinders is most probably a deliberate act, which is disadvantageous to consumers as they don't get value for their money. In line with the consumer protection act of 2012, the customer should receive all the product purchased (World LPG Association, 2015)
The main challenges that hindered compliance with occupational safety and health requirements were ignorance, lack of awareness on the importance of safety in the lpg retail business, lack of pieces of training and sensitization on lpg safety, and the high costs associated with lpg safety enhancement.

The researcher recommends that the Energy and Petroleum Regulatory Authority (EPRA) should keep an up to date online register of licensed Lpg retailers, that is accessible to the public. The authority should also undertake routine inspections and compliance monitoring in all lpg retail centers. Lpg retailers should develop clear and simple safety policy guidelines, by consulting approved persons by the Directorate of Occupational Safety and Health Services (DOSHs), that will help ease the understanding of the safety requirements and consequently improve compliance. Besides, engineering breakthroughs should be sought after Lpg cylinder safety advancement.

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