COMPLIANCE WITH OCCUPATIONAL SAFETY PRACTICES AMONG COOKING GAS REFILL STATION ATTENDANTS IN EFFURUN AND ENVIRONS, DELTA STATE, NIGERIA

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DOI: 10.51865/JPGT.2025.01.01

ABSTRACT

To minimize the risk of accidents and injuries, it is essential to assess how safety protocols are being adhered to in the workplace. Many attendants working at stations that refill cooking gas in the gas retail sector are found in this study location, Delta State of Nigeria. Such workers are exposed to numerous risks that can lead them to get injured, gas leakage, and fire. This study assessed the compliance of cooking gas refill station attendants in Effurun and its environs in Delta State with occupational safety practices. The study used cross-sectional and descriptive designs such as observations and interviews for qualitative data collection. The data was presented quantitatively as numerical values, from which statistical inferences were drawn. The study found that knowledge of safety practices among cooking gas refill station attendants in Effurun and its environs was generally good, especially regarding personal protective equipment (PPE) usage (85.4%), fire extinguishers (100%), and familiarity with workplace safety practices (95.8%). The study's results showed statistically significant associations and relationships between the respondents' age with awareness and knowledge (p=0.041) and duration of work time (p=0.018). Additionally, the general practice of safety measures was found to be high. However, some cooking gas refill stations had poor design and siting, which could increase the vulnerability to occupational accidents within the stations. To improve compliance, assessing occupational safety practices should be a top priority. This will positively influenced organizational improvement approaches and hazard management at cooking gas refilling stations in Nigeria.

Keywords: occupational safety, compliance, cooking gas, refill stations, assessment, hazard

INTRODUCTION

The safety of workers stands as an indicator of success in every occupation and can also show the life expectancy of employees. Workers are expected to be in an environment free from hazards that may threaten their survival [19]. Typical oil and gas retail outlet workers are continually exposed to possible scenarios that could lead to accidents and

diseases, currently the leading contributor to safety risks workers face [21]. The 2014 International Labour Organization (ILO) document states that occupational safety and health (OSH) ensure the promotion and maintenance of employees' social, physical and mental well-being in all workplaces [11]. According to the initial combined estimates from the International Labour Organization (ILO) and the World Health Organization (WHO) presented in the Global Monitoring Report, work-related illnesses and injuries resulted in 1.9 million fatalities in 2016. Of these deaths, around 360,000, or 19%, were attributed to occupational injuries [28]. Regardless of the improvements in the field of OSH focused on protecting workers, occupational hazards and risks still need to improve for workers in developing countries. Challenges encountered by most establishments in the protection of the health and safety of workers have been connected with the failure of employers and workers to comply with safety measures [27]. According to Ahmed et al. [1], best safe practices such as the use of portable fire extinguishers, spill kits, Personal Protective Equipment (PPE), recording of accidents, and reporting of hazards go a long way in averting injuries, accidents, and diseases at the place of work.

The 2006 International Energy Agency (IEA) report shows that the dominant household energy usage in most developing countries, like Nigeria, is for cooking [26]. According to Buba et al. [7], the common fuels for residential cooking in Nigeria consist of animal dung, crops, grass, wood, charcoal, coal, kerosene, biogas, natural gas, LPG and electricity. Biomass and solid fuels like wood, coal, and charcoal leave residues frequently burned directly on open fires or incompletely combusted in traditional cooking stoves [3]. These residues are environment-unfriendly and play a significant role in climate change as they release hazardous gases, suspended liquids and solid particles, creating serious public health issues [25]. However, traditional energy sources such as firewood, charcoal, dung and crop residues constitute the bulk of Africa's energy consumption and remain an essential impediment to households' shift to modern clean fuel [18]. The vast majority of the developing world has persistently struggled to ensure an accelerated rapid disposition to affordability & access to clean energy [13]. Globally, the use of LPG for cooking has been increased [23].

Cooking gas, or LPG, is stored as a liquid under pressure in metal containers and used for heating and cooking in places without a gas supply [4]. Unlike other European countries, Nigeria has not planned a natural gas distribution network for household cooking; as such, domestic distribution of cooking gas has been through branded gas cylinders [16]. The environment of such gas refill retail outlets/stations exposes gas station attendants (workers) to numerous safety risks and health hazards. Also, there is a growing number of cooking gas refill/retail outlets/stations on road corridors, in and around residential quarters, and in densely populated areas all over the country, thereby hindering adequate supervision and enforcement of safety compliance measures. This poses a problem regarding the safety of citizens, specifically residents and workers in those places. The cooking gas refill station attendant performs general cooking gas/LPG gas pump maintenance and helps keep the property clean [5]. The attendants predominantly work outdoors at the gas station lot and may sometimes provide outdoor service for gas cylinders. Gas attendants pump cooking gas into customer cylinders based on the required amount.

Cooking gas refill stations employ several attendants in the gas retail sector in Delta State. Fire load is a primary safety concern in cooking gas refilling outlets/stations as it increases their vulnerability to fire or explosion-related accidents. Attendants/workers in the LPG stations can sustain injuries in fire accidents [8]. Research conducted by Rocha et al. [24] and Gaikwad et al. [9] opined that some gas station attendants are not putting on personal protective equipment (PPE), part of the safety measures in a hazardous gaseous environment. Given the increasing number of gas refill stations in Effurun and its environs, it is essential to assess the occupational safety practice level of cooking gas refill station attendants to avert the high morbidity and mortality associated with accidents from cooking gas refill stations.

MATERIALS AND METHODS

Study Areas

Effurun is the capital and administrative centre of the Uvwie Local Government Area (LGA) in Delta State, South-South Nigeria. The Effurun metropolis is between latitude 50° 30' N - 50° 45' N and longitude 50° 15' E - 50° 50' E [1]. The town has an estimated area of 960 km^2 and features small rivers and tributaries. It experiences a tropical savannah climate, with typical temperatures averaging around 25°C and receiving approximately 3,050 mm of rainfall yearly.

Figure 1 presents a map of Nigeria, showing the location of Delta State and the specific areas where samples were gathered for the study.

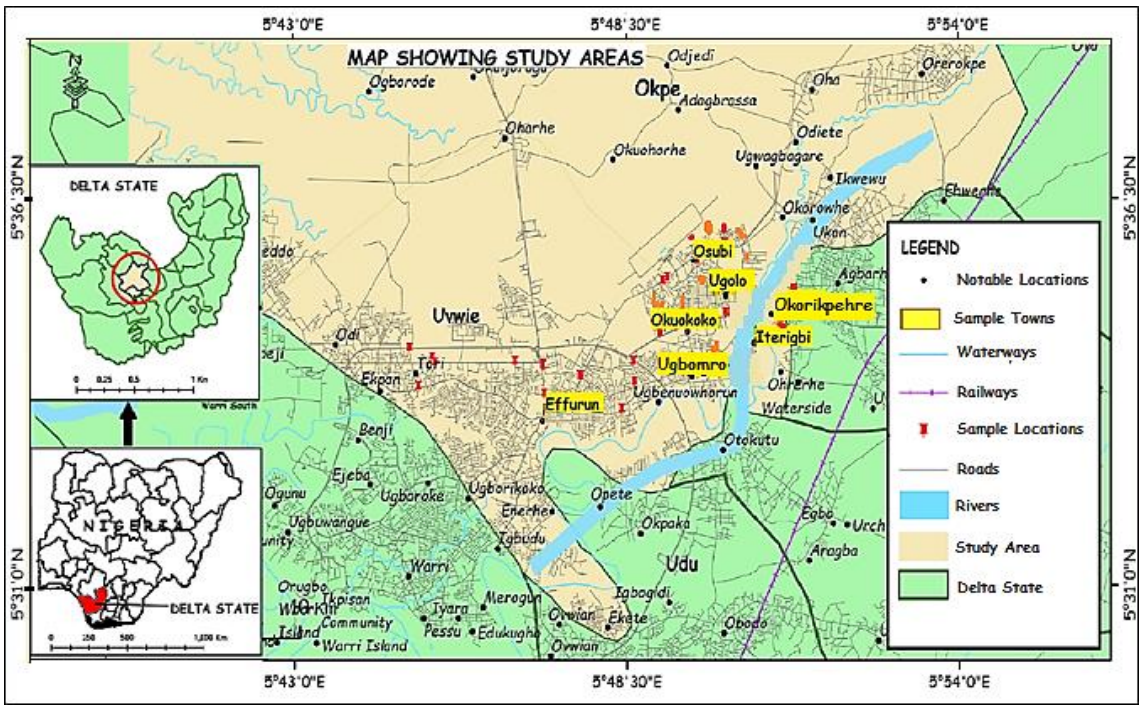

Figure 1. *Map showing the study area and sample locations*

Study Approach

This research is systematically designed to observe, gather, analyze and interpret the data obtained. The study adopts a cross-sectional survey design and uses a structured questionnaire. The data analysis was done using the Statistical Package for the Social Sciences (SPSS version 25). Subsequently, descriptive statistics such as frequencies and percentages were used to summarise the data. The dependent variable compliance constitutes the outcome achieved when various safety measures are in place.

To determine the attendants' compliance with safe practices, the study evaluated some specific routine and non-routine occupational safe practices peculiar to cooking gas refill stations, such as the use of PPE, sand buckets, fire extinguishers, recording of unsafe acts, unsafe conditions, near misses and accidents. Other independent variables included age, sex, and socio-demographic factors, such as level of education and years of work experience. Knowledge and attitude were also considered independent variables in this study.

The study surveyed cooking gas refill station attendants selected using purposive sampling. Twenty-six (26) stations were randomly chosen in municipalities such as Effurun, Ugbomro, Iterigbi (Iteregbe), Okuokoko, Ugolo, Osubi and Okorikpehre.

Sample Size

The study's sample size for cooking gas refill station attendants in Effurun and surrounding areas was determined using Anderson et al.'s [4] formula for an infinite population (Equation 1).

$$n = \frac{z^2 pq}{e^2} \tag{1}$$

Where,

n = the sample size desired

Z = the normal standard deviation and the score for confidence interval desired at 95% (i.e. 1.96)

p = proportion of the target population with a probability of compliance with occupational safety practice herein given in this study as a prevalence value of 0.752, which was gotten from the compliance with safety practice as reported from a similar study carried out by Joshua et al. [12] in Zaria Metropolis, Kaduna State, Nigeria.

q = the proportion of the population used as the control sample, given as (1-p)

Thus,

$$q = 1 - p \tag{2}$$

Substituting the value of "p" into Equation 2,

$$q = 1 - 0.752$$

$$q = 0.248$$

e = acceptable sampling error of 5% (i.e. the value at 95% confidence level) is given as 0.05.

Therefore, substituting all values into Equation 1 gives:

$$n = \frac{1.96^2(0.752 \times 0.248)}{0.05^2}$$

$$n = \frac{0.71644}{0.0025}$$

$$n = 286.576 \cong 287$$

The sample (n) is given as 287.

The number of cooking gas refill station attendants in this study's designated areas was few and considered less than 10,000 under normal circumstances. Hence, 287 is the estimated total number of attendants in the study's selected stations. Consequently, to adjust the sample size to the desired sample, the formula employed by Kyalo [14], as presented in Equation 3, was used to calculate the sample size.

$$nf = \frac{(n \times N)}{(n + (N-1)} \quad (3)$$

Where,

nf = sample size desired when the target population is less than 10,000,

n = sample size desired when the target population is greater than 10,000

N = estimate of the population size

Therefore,

$$nf = \frac{(287 \times 287)}{(287 + (287 - 1)}$$

$$nf = \frac{82{,}369}{573}$$

$$nf = 143.750 \cong 144$$

RESULTS AND DISCUSSION

Respondents' Gender Distribution

The gender distribution of the 144 respondents was assessed, and the results are presented in Figure 2.

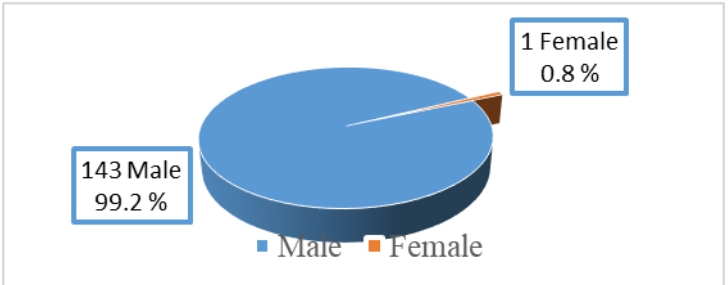

Figure 2. *Respondents' gender distribution*

In Figure 2, 99.2% of the 144 respondents were male, and only 0.8% were female. This shows that cooking gas refill station operations in Effurun and its environs are male-dominated. This aligns with previous studies, including Oluoch et al. [22], which found that males are more likely to work in high-risk jobs. Joshua et al. [12] also found that all respondents in their study were male.

Respondents Age Distribution

The age distribution of the study's respondents is presented in Figure 3. Figure 3 shows that most respondents were between 26 and 35, representing 64.6 %. Respondents aged 18 to 25 accounted for 27.1 %, while those aged 36 to 45 were the least represented at 8.3 %. These findings suggest that most cooking gas refill station attendants in Effurun are aged 26 to 35 and are considered mature and energetic. Age is essential in descriptive research analysis, as it can significantly influence responses [17].

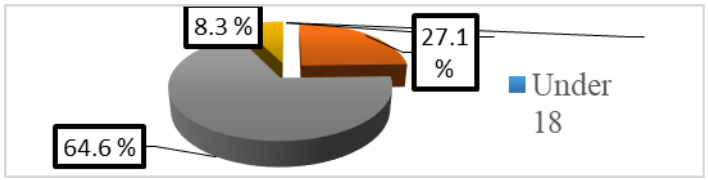

Figure 3. *Respondents' age distribution*

Respondents' Education Levels Distribution

The academic/educational accomplishment of the respondents was evaluated, and the results are presented in Figure 4. According to the results in Figure 4, none of the respondents had primary education, but 80% had post-primary education. Most respondents had a degree, and managers/supervisors mostly had tertiary education. Consequently, they are considered knowledgeable to answer the questions on the issues under study.

Figure 4. *Respondent's education level distribution*

Respondents Working Experience Distribution

Figure 5 shows the sampled stations' operational duration (in years), while Figure 6 displays respondents' working experience at gas refill stations. Figure 5 reveals that 62 % of stations operated for 2-5 years, while only 38% for 5+ years. Each station operated for at least 2 years.

Figure 6 shows that 79% of respondents had 1-5 years of experience in cooking gas refill stations. The business is thriving due to the presence of many entrants in the past five years. More people in Effurun and its environs are switching to cooking gas as their preferred energy source due to the cost of other energy sources.

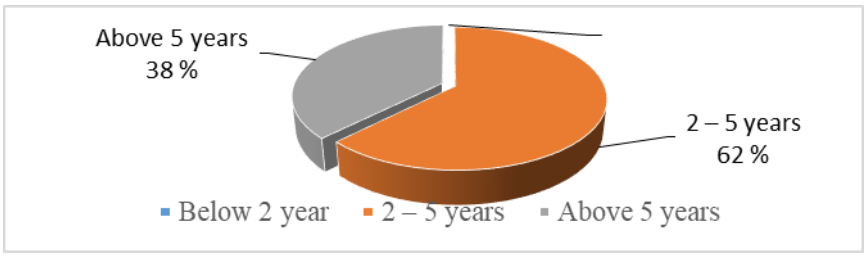

Figure 5. *Years of operation (in years) sampled cooking gas refill stations*

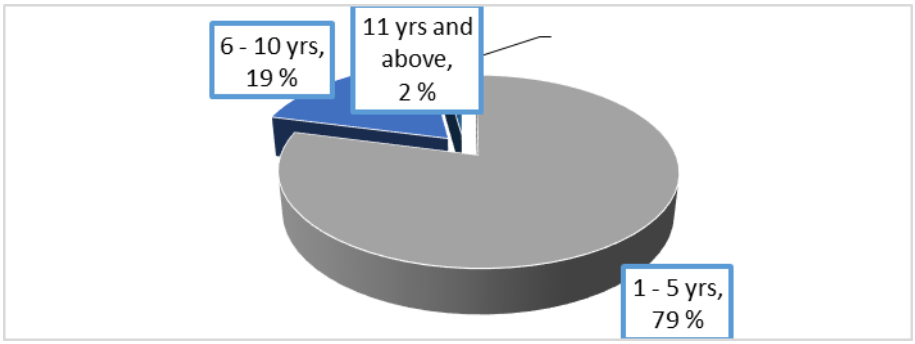

Figure 6. *Respondents working experience in distribution*

Hours Worked Each Day

Results in Figure 7 show the duration of working hours per day of respondents in this study. The study found that 27% worked under 8 hours daily, 45% worked 8-10 hours, 25% worked 11-12 hours, and only 3% worked over 12 hours. Most staff worked 8 to 10 hours without a break between shifts. This is consistent with Kyalo's [14] study, where 86.7% worked 8-10 hours/day.

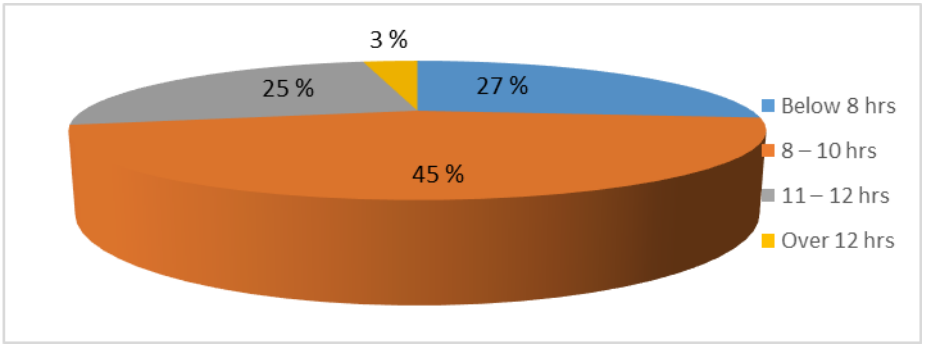

Figure 7. *Distribution of working hours per day of respondents*

Awareness and Knowledge of Safe Practice

Most participants in the study understand workplace safety practices, such as protective clothing and equipment usage, hazard reporting, and accident recording. However, fewer respondents know about other safety measures. Also, 85.4% of respondents received training before working at the cooking gas station. Consequently, Figure 8 shows that 25.7% of respondents believed that the top management is responsible for implementing safety practices, while 54.2% reported that supervisors are responsible. Only 6.3% stated that they were responsible. However, 13.9% reported that the responsibility lies with top management, supervisors, and employees themselves.

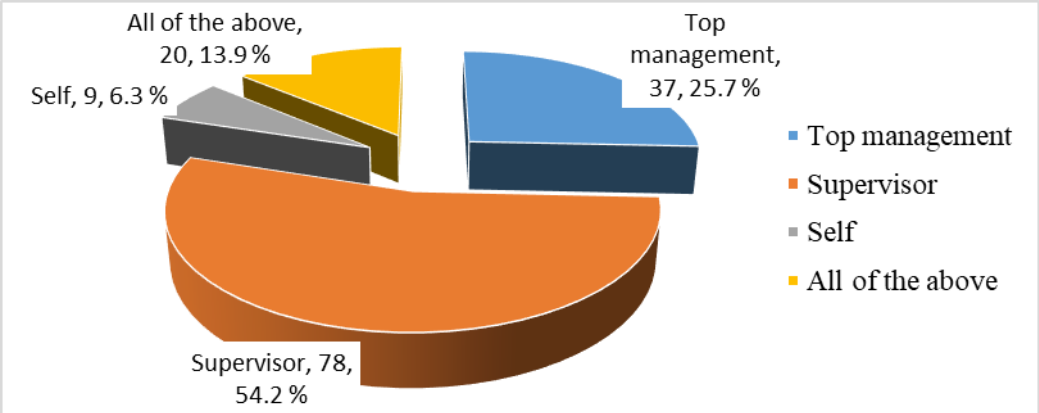

Figure 8. *Those responsible for implementing safety practices at workplaces*

Attitude towards Compliance with Safe Practice

All 144 respondents (100%) consider safety practices crucial. The use of personal protective equipment, the recording of accidents, the reporting of hazards, and the use of portable fire extinguishers are also deemed necessary by all respondents (100%). Inadequate safety equipment availability is the biggest challenge for 84 respondents (59.6%); 64 respondents (45.4%) consider the poor state of safety equipment the primary challenge, while 39 respondents (27.7%) believe poor design and siting of cooking gas stations and 66 respondents (43.3%) consider low worker knowledge the main challenges. Despite some safety equipment unavailability, workers at cooking gas refilling stations acknowledge the importance of safety practices.

Compliance with Safe Practices

The respondents' compliance rates with safe practices ranged from 43.8% to 56.2%. On the contrary, there are mostly a few incidents when there is no compliance at work, for example, if the workers do not wear personal protective equipment and document accidents/near misses. Nevertheless, personnel safety has been observed to be one of the sectors that elude strict regulations, she said. Workplace safety should be adhered to strictly, and companies should invite guidelines allowing safety to run freely in the workplace. Safety works as long as legislation is followed in every aspect, thus reducing the possibility of injury and increasing productivity.

Safety Policy

A company's safety policy is a written declaration of its commitment to safeguard the health and safety of employees and the community. The results of this study also indicate that 83.3% have a safety policy, but only 52.8% are aware of safety laws. While all supervisors discuss safety, only 50.7% know how to report accidents. Employee behaviour, expectations, job satisfaction, and adequate equipment prevent negative occurrences. Also, the results show that more than 80% of respondents underwent mandatory training before employment. Managers and supervisors confirmed having safety policies and measures in place to ensure staff safety, including safety training and preventive procedures. The survey revealed that 60% of respondents did not face difficulties enforcing safety policies, while 40% did. The results indicate that managers and supervisors are committed to ensuring a safe work environment and recognize the importance of safety policies in the workplace.

Observation Checklist Analysis

Plates 1 to 4 show pictures of gas refill outlets visited. Table 1 shows results from the observational checklist for these outlets. The checklist helps focus on the study objectives.

Plate 1. *Visible fire extinguishers*

Plate 2. *Visible hydrant horse for firefighting*

Plate 3. *Attendants without complete PPE*

Plate 4. *Visible safety signs*

Table 1. *Observation Checklist Analysis*

Requested basic information	**Response distribution (%)**		
	Yes (%)	**No (%)**	**Total (%)**
FIRE EXTINGUISHERS: Are they visible?	33 (91.7)	3 (8.3)	36 (100)
The refill/dispensing area must have a minimum of 2 x 9 kg Dry Chemical Powder ABE type extinguishers.	33 (91.7)	3 (8.3)	36 (100)
Is the fire extinguisher charged and ready for use? (i.e., the needle in the pressure gauge of all fire extinguishers in the green area).	33 (91.7)	3 (8.3)	36 (100)
A yellow maintenance tag is attached and embossed with a date mark of the last inspection within the previous 6 months.	9 (25)	27 (75)	36 (100)
PPE: Do pump attendants have any protective equipment on?	30 (83.3)	6 (16.7)	36 (100)
Hand protection? e.g. gloves	15 (41.7)	21 (58.3)	36 (100)
Respiratory protection? e.g. nose mask	15 (41.7)	21 (58.3)	36 (100)
Body protection? e.g. apron, special uniforms with long sleeves	33 (91.7)	3 (8.3)	36 (100)
Foot protection? e.g. Boots	24 (66.7)	12 (33.3)	36 (100)
SAFETY SIGNS	36 (100)	0 (0)	36 (100)
Emergency Exits	24 (66.7)	12 (33.3)	36 (100)
Mustering Points	33 (91.7)	3 (8.3)	36 (100)
Other Safety Signs	36 (100)	0 (0)	36 (100)
SAFETY EQUIPMENT - List	12 (33.3)	24 (66.7)	36 (100)
ROUTINE SAFETY EQUIPMENT MAINTENANCE CHECKLIST	6 (16.7)	30 (83.3)	36 (100)
TRAINING SCHEDULE CHECKLIST	0 (0)	36 (100)	36 (100)
TOTAL	372 (64.6)	204 (35.4)	576 (100)

Association between Awareness and Knowledge of Safe Practices and Socio-Demographic

Table 2 shows the results of analyzing study variables such as age, gender, level of education, years of experience, and working hours. There is no significant association between gender and safe practice awareness. Age and working hours have a significant association with safe practice awareness. However, there is no significant association between the level of education and years of experience with safe practice awareness.

Table 2. *Association between Awareness and Knowledge of Safe Practices and Socio-Demographic*

	Awareness and Knowledge							
		Yes	**No**	**Total**	**Chi-Square**	**df**	**p-value**	**Decision**
Gender	Male	115	28	143	0.2430	1	0.622	Not Significant
	Female	1	0	1				
Age	18-25 yrs	27	12	39	6.388	2	0.041	Significant
	26-35 yrs	77	16	93				
	36-45 yrs	12	0	12				
Education	Secondary	17	1	18	6.04	3	0.11	Not Significant
	Diploma	40	16	56				
	(PG)	44	9	53				
	Others	15	2	17				
Experience	1-5 yrs	107	28	135	2.317	1	0.128	Not Significant
	6-10 yrs	9	0	9				
Work Time (Hrs)	<8	32	16	48	10.016	3	0.018	Significant
	8-10	42	8	50				
	11-12	36	4	40				
	>12	6	0	6				

Association between Attitude towards Compliance with Safe Practices and Socio-Demographic

Table 3 shows that socio-demographic factors are associated with attitudes towards compliance with safe practices among cooking gas refill station attendants in Effurun. Pearson Chi-square tests found no significant association between gender, age, and level of education. However, there was a significant association between years of experience working hours and attitudes towards compliance with safe practices.

Table 3. *Association between Attitude towards Compliance with Safe Practices and Socio-Demographic*

		Attitude						
		Yes	**No**	**Total**	**Chi-Square**	**df**	**p-value**	**Decision**
Gender	Male	96	47	143	0.4879	1	0.4849	Not Significant
	Female	1	0	1				
Age (years)	18-25	21	18	39	4.486	2	0.106	Not Significant
	26-35	67	26	93				
	36-45	9	3	12				
Education	Secondary	11	7	18	7.624	3	0.054	Not Significant
	Diploma	34	22	56				
	PG	43	10	53				
	Others	9	8	17				
Experience (Years)	1-5 yrs	88	47	135	4.652	1	0.031	Significant
	6-10 yrs	9	0	9				
Work Time (Hrs)	<8	48	0	48	45.323	3	0.000	Significant
	8-10	28	22	50				
	11-12	15	25	40				
	>12	6	0	6				

Association between Safe Practices Adoption towards Compliance with Safe Practices and Socio-Demographic

Table 4 shows no significant association between the socio-demographic factors of gender, age, level of education, years of experience, and working hours and the adoption of safe practices among cooking gas refill station attendants in Effurun and its environs. The Pearson Chi-square test results indicate that none of these factors are associated with adopting safe practices and complying with them.

CONCLUSIONS AND RECOMMENDATIONS

This study successfully examines the occupational health and safety practices in cooking gas refill stations in Effurun and its environs, Delta State, Nigeria. The study results revealed that safe behaviours were the presence of safety signs and firefighting equipment, wearing uniforms and personal protective equipment (PPE), and adherence to warning signs and symbols. Nevertheless, PPE has yet to be fully implemented (83.3% of respondents used PPE). The study concludes that although most participants present adequate knowledge and a positive attitude toward safety practices, there is still significant room for improvement. The study results showed a statistically significant relationship between respondents' age, working hours, work experience and knowledge of safety practices. This will positively impact safety practices and hazard management in cooking gas refill stations across Nigeria.

Table 4. *Association between Safe Practices Adoption towards Compliance with Safe Practices and Socio-Demographic*

	Safe Practices							
		Yes	**No**	**Total**	**Chi-Square**	**df**	**p-value**	**Decision**
Gender	Male	139	4	143	0.0287	1	0.8653	Not Significant
	Female	1	0	1				
Age	18-25 yrs	36	3	39	4.828	2	0.089	Not Significant
	26-35 yrs	92	1	93				
	36-45 yrs	12	0	12				
Education	Secondary	17	1	18	3.893	3	0.273	Not Significant
	Diploma	53	3	56				
	PG	53	0	53				
	Others	17	0	17				
Experience (Years)	1-5 yrs	131	4	135	0.274	1	0.601	Not Significant
	6-10 yrs	9	0	9				
Work Time (Hrs)	<8 hrs	46	2	48		3	0.888	Not Significant
	8-10 hrs	49	1	50	0.638			
	11-12 hrs	39	1	40				
	>12 hrs	6	0	6				

Like Landucci et al. [15], this study opined that LPG, as cooking gas, has a high volumetric expansion coefficient; therefore, cylinders and tanks should never be filled up to maximum capacity. Consequently, they should be filled with an ullage or headspace (i.e. the volume left empty so that there is space for the gas in the cylinder to expand) to allow for liquid expansion caused by an increase in temperature [10]. The degree of ullage or headspace necessary will depend on the operating conditions, especially the maximum expected operating temperature. This potential risk is further controlled by a combination of safety devices and procedures, especially by control during product transfer operations. This potential risk explains why cylinders and tanks should only be filled under the supervision of competent persons and why illegal filling is dangerous [20].

Recommendations to boost compliance with occupational safety practices at cooking gas refill stations include:

i. Prioritize safety practice assessments to identify areas of improvement,

ii. Educate attendants on the importance of PPE, reporting hazards, and recording accidents,

iii. Make PPE provision and use mandatory based on regulatory guidelines,

iv. Provide refresher training regularly for longer-serving attendants,

v. Conduct further research on health problems and the role of customers in implementing safety practices.

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Received: October 2024; Revised: December 2024; Accepted: January 2025; Published: January 2025