

A Review of Sir Thomas Legge's Aphorisms and Workplace Personal Protective Equipments – Is There Gap in Knowledge, Attitude and Utilization?

Emmanuel N Aguwa*

Occupational Health Physician, University of Nsukka, Nigeria

Abstract

Sir Thomas Legge and other researchers have long established the need to protect workers from workplace hazards. Protection of workers from workplace hazards is crucial to reduce mortality and morbidity in the workplace. Many of these morbidity and mortality occur long after the workman has left the work. Hence besides other control measures it becomes important to assess compliance of the employer/employee with personal protective equipment (PPE).

Methods: Secondary data were collected from previous literatures involving different occupations in different countries. Results in most studies showed poor knowledge of work hazards/PPE, attitude and utilization of PPEs in most occupations. The commonest reasons for poor utilization of PPEs were discomfort, reduction in work efficiency, emergency nature of work and feeling of low vulnerability of worker to hazard.

Conclusion: Besides making appropriate PPEs to be always available, focus should be at attitudinal change of workers to make them and their employers think "safety first".

Keywords: Personal protective equipment; Workplace; hazard; Sir Thomas Legge; Employer

Introduction

Many years ago workers were at the mercy of the hazards in their workplaces. The area of focus then was on work output and little or no attention to the morbidity and mortality associated with such work. However, over the years there has been an increasing awareness of the hazards workers are exposed to in the workplace. This is largely due to contributions of people like Georgius Agricola, Philippus Paracelsus, Hippocrates, Bernadino Ramazzini, Charles Turner Thackrah, Lord Anthony Ashley Cooper, Sir Thomas Morrison Legge and several others. Sir Thomas Morrison Legge (1863 – 1932) in three of his five aphorisms stated the following -

First aphorism - "Unless and until the employer has done everything and everything means a good deal - the workman can do next to nothing to protect himself; although he is naturally willing enough to do his share" [1].

Fourth Aphorism - "All workmen should be told something of the danger of the material with which they come into contact and not be left to find it out for themselves - sometimes at the cost of their lives" [1].

Fifth aphorism - "Examples of influence - useful to a point, but not completely effective - which are not external, but depend on the will or the whim of the workers to use them, are respirators, gloves, goggles washing conveniences and waterproof sand paper" [1].

By above aphorisms he emphasized the need for employers to do everything to protect the employee. Basically in the order of priority for workplace hazard control the employer should think of: elimination by substitution of agent or process, engineering control, administrative controls, good work practices and provision and use of personal protective measures. Personal protective equipments (PPEs) are placed last because the employers of labour should concentrate on the other control measures and use the PPEs as complimentary control measure. Personal Protective Equipment (PPEs) or Personal Protective Devices (PPDs) are designed to protect employees from serious workplace

injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. They include face shields, safety glasses/goggles, hats/safety helmets, safety shoes, coveralls, gloves, ear protection (ear plugs and muffs), vests, respirators, etc [2]. Often, more than one of these PPEs are worn at same time in workplace depending on the work exposure e.g. a farmer is expected to wear safety boots, facemasks/respirator (if he is using pesticide spray) and gloves.

The need for these PPEs has increased over the years with increasing awareness of workplace hazards, and the difficulties associated with overdependence on other control measures which for some agents cannot be totally eliminated or even monitored. Most large scale companies have therefore established policies on PPE [3-7]. While in some work environments, the non-compliance to PPE policy may not result in significant health problems, for some other occupations failure to comply with PPEs could determine the difference between life and disability or even death e.g. in nuclear power plants.

Several studies have been done to evaluate the knowledge, attitude and use of these PPEs by workers in different occupations. Findings from these studies differ widely from one study to another and hence raising certain questions: Do the workers know about workplace hazards? Do they know the appropriate PPEs and how to use them? What is their attitude to and utilization of these PPEs? What factors influence utilization of these PPEs? Has the employer done everything

*Corresponding author: Emmanuel N Aguwa, Occupational Health Physician, University of Nsukka, Nigeria, E-mail: enaguwa@yahoo.com

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(Sir Thomas Legge aphorism) by providing PPEs and educating the employer on work hazards? If yes then why are some workers not wearing them? The relevance of this review is to assist in highlighting what gap exists between the employer and utilization of the PPEs by employees.

The aim of this literature review is therefore to obtain, from previous works, the knowledge, attitude and utilization of PPEs by various occupations.

Methods

The source of information was secondary data. Present article reviewed at least 40 past research works spanning several years (from 2000 to 2013) and done on different occupations in different countries (both developed and developing). Information was obtained from Google search for various occupations and separated into knowledge, attitude and use of the PPEs. Reasons for non utilization were also obtained. Since the research focus is on non users of PPEs, proportions not using the PPEs were obtained by subtracting the proportions using it (from the literature) from 100%. All the data are in percent.

Study limitation

Convenience method was used to select literature and hence may not be true representation of all available data. Information for some occupations on use of PPEs could not be obtained. Data in some selected manuscripts were also not complete.

Results

Table 1 shows a very wide range of knowledge of hazards/PPEs among various occupation: range was 3.7% (for Rattan craftsmen in a study in Vietnam) to 97.9% (for pesticide sprayers in Gaza Strip) [8,9]. Attitude towards using PPEs also vary from good (Steel Plant in India) to poor (Traditional Resist Fabrics in Nigeria and Rattan Craftsmen in Vietnam) [8,10,11]. In most cases the attitude of the workers to use of PPEs is negative with the commonest reason being that it is inconvenient and disturbs their work (Table 2). Utilization of the PPEs also varied widely and not complied with by all workers in any of the occupations studied. Most (70%) construction workers did not wear ear protective device while few (8%) did not put helmet while working [12]. Most (71%) cement workers did not wear facemasks while working. Among renovation workers most did not put on complete PPEs e.g. 91% of workers did not wear protective clothes [12]. During embalment 19% did not wear gloves [13]. In the health sector

Occupation	Workers who were knowledgeable about exposure to hazards/PPE (%)
Pesticide sprayers (Gaza Strip) [9]	97.9
Farmers (Brazil) [17]	87.5
Steel Plant (India) [10]	83.9
Nurses during hazardous clinical activities (Cypriot) [14]	79.4
Printing workers [43]	62
Quarry (Nigeria) [20]	57.3
Sawmill (South Africa) [19]	53
Funeral Home Workers (Lagos, Nigeria) [13]	50
Chilli-growing farmers (Thailand) [44]	23
Poultry workers (Nigeria) [45]	22.3
Traditional Resist Fabrics workers (Nigeria) [11]	21.9
Rattan Craftsmen (Vietnam) [8]	3.7

Table 1: Knowledge of PPE and/or harmful effects of workplace exposure.

most nurses (96.6%) did not wear goggles in theatre, however only a few (14.8%) did not wear gloves [14]. Many farmers wear PPEs like helmet, safety boot, mask, glove and protective clothes [15-17]. While few welders (11%) did not wear PPE most sawmill (62%) and Quarry (66.6%) workers did not wear any PPE [18-20] (Table 3).

The commonest reasons for not wearing PPEs include interference with work, belief that the agent is not harmful, discomfort, emergency situation of work (e.g. for health workers in taking care of patients during emergency), non availability of PPE and lack of knowledge (Table 4).

Discussion

No one measure is enough to control hazards of the workplace. This is compounded by the fact that in most occupations several hazards may exist with each acting same time or at various times during the work period. Hence the role of personal protective measures in the workplace as supplementing other control measures cannot be overemphasized. This is particularly important in small scale industries in developing countries where not much investment is in place for the other control measures. Compliance to PPEs has therefore generated a lot of interest since it is one of the control measures that are easily feasible and assessable to monitoring and evaluation. It has been recognized that for effective utilization of PPEs responsibility lies with both employer and employee. Indeed for effective utilization of PPEs the University of California Environmental Health and Safety Unit has stipulated certain responsibilities for the employer/supervisor and another for the employee [21]. Some of the responsibilities of the supervisors include providing PPEs as required or upon request to all employees; ensuring PPE is being used by affected employee during all job tasks requiring such protection and conducting specific hazard assessments for PPE use upon request. The responsibilities of employees include inspecting all PPE before its use; wearing PPE upon the direction of their immediate supervisor; participating in mandatory training; notifying their supervisor when new PPE is necessary; contacting Environmental Health and Safety when a hazard or process has changed which may render previously used PPE ineffective and notifying their supervisor of any changes which might impact on the type of PPE they use [21].

Hence though Sir Thomas Legge puts most responsibilities of controlling workplace hazards the aphorisms are all inter-related.

Sir Thomas Legge first aphorism

“Employer’s responsibility to employee...” In the context of PPEs the questions this aphorism raises are: were all employees provided with PPEs? Routine monitoring and evaluation of workplace is uncommon in developing countries. Sir Thomas Legge has pointed out the increased responsibility of the employer to do everything to protect the workman. So, ensuring the other control measures are in place, employer is also responsible for providing and ensuring the utilization of the PPEs by enforcing the Policy on PPEs and including incentives or punishment

Occupation	Workers with Positive/Good attitude towards wearing the PPE (%)
Steel Plant (India) [10]	92
Chilli-growing farmers (Thailand) [44]	45.5
Sawmill (South Africa) [19]	41
Traditional Resist Fabrics workers (Nigeria) [11]	4.2
Rattan Craftsmen (Vietnam) [8]	4.2

Table 2: Occupations and proportion of staff with positive/good attitude towards using PPE.

Occupation	Workers not complying with PPE (%)								
	Helmet	Safety boot	Goggle	Respirator	Mask	Glove	Protective Clothes	Safety belt	Ear plug/muff
Construction worker [12]	8	35	49	59				50	70
Cement worker (UAE) [27]					71*				
Renovation worker [12]	66		62			55	91	74	80
Printing [43]						24.4			
Funeral Home (Nigeria) [13]						19			
Rattan Craftsmen (Vietnam) [8]				71					
Dyeing and Printing (India) [30]						66			
Greenhouse workers (Italy) [46]						50			
Orchard farmer [47]		65	65	55		32			
Pesticide sprayers (Gaza Strip) [9]		85.2	92.1		78.3	80.4	81		
Nurses (Cypriot) [14]			96.6		86.4	14.8	56.6		
Emergency medical technicians (Canada) [24]				8.5					
Fabrics workers (Nigeria) [11]					71				
Farmers (USA) [16]	17.9	59.8	77.3			61.6			
Farmers (Brazil) [17]	30.4	21.4			27.7	42.9	41.1		

*100% of workers were provided with masks

Table 3a: Occupations and proportions of workers not always wearing PPE during work.

Occupation	Workers not complying with PPE (%)			
	Helmet	Wrist guard	Kneepads	No PPE*
Chilli-growing farmers(Thailand) [44]				15
Steel Plant (India) [10]				27.5
Youth skaters [48]	87	97	99	
Welders (South Africa) [18]				11
Farmers (Australia) [15]				10 – 40
Sawmill (South Africa) [19]				62
Quarry workers (Nigeria) [20]				66.6

*Type of PPE not mentioned

Table 3b: Other Occupations and proportions of workers not always wearing PPE during work.

Occupation	Reasons for not using PPE	Percent
Construction workers [12]	Reduced work efficiency	27
Printing workers [43]	Interference with work	58.3
	Believe that chemicals were not harmful	20.0
	Discomfort	13.9
Emergency medical technicians during SARS (Toronto) [24] – Air filter	Too rushed at scene	23.9
	Not necessary	21.7
	Not required	6.5
	Impaired movement	2.2
Surgical Nurses [49]	Non-availability	37
	Interfered with patient care	32
	Lack of time	19
	Feeling that the PPE is inefficient	9.8
Quarry (Nigeria) [20]	Lack Knowledge	70.8
	PPE Uncomfortable	16.1
	Not important	13.1

In focused group discussion among skaters, the two commonest reasons for not wearing PPEs were unnecessary, uncomfortable and restrictive [48]. In a Gambian study the reasons included high cost, unavailability, improper fit and unsuitable to weather [49,50].

Table 4: Reasons given by workers for not wearing the PPEs.

to compliance or default respectively. In most literatures studied PPEs were not always provided. Even where PPEs were provided some did not fit the intended user. In a study among pesticide sprayers, PPEs were not provided to some staff. Even among those who were provided, some were either unfit (18%) or worn-out (29%) [22]. In another study on paramedics in USA lack of access to safety devices was identified as the major barrier to use. Some studies associated improved use of PPEs with availability. Indeed there was up to 40% increase to its use when the devices were always available [23]. This shows that provision of PPEs would improve its utilization. However there were circumstances where everyone had 100% access to PPEs and yet the utilization was

not optimal. This is particularly observed in hospital settings [24]. Even during outbreaks, PPE was still not worn by all staff e.g. in outbreak of Severe Acute Respiratory Syndrome (SARS) the proportion of staff that always wore PPEs were as follows: 19.3% (eyewear), 91.5% (N95 respirator), 7.9% (open face hood), 35.7% (face shield), 41.0% (gown), 39.2% (double gloves) and 77.6% (airway filter) [24]. Interestingly in such biological hazards, like seen in hospitals, where the hazard is infectious use of PPEs was observed to not only protect the worker but result in significant reduction in nosocomial infection among hospital staff e.g. during SARS epidemic [25,26].

Sir Thomas Legge fourth aphorism

Are workers told everything about the hazards they work with? Findings from different studies show different levels of knowledge, among workers, of the diseases caused by the hazards they are exposed to. In some cases these workers do not also know even how to use PPEs and why they should use it.

In terms of knowledge of workers on their specific health hazards, some studies indicate poor knowledge of workers on their health hazards. Among cement workers 25% of the workers did not know about dust illness [27]. In another study among construction workers only 70% and 60% recognized the need to wear helmets and safety belts respectively [12]. In support of this a study done among workers of block carbon factory showed that the application intervention on the basis of BASNEF model was effective in enhancing the use of safety equipments among the workers [28]. The study concluded that though there may be other confounding variables improved knowledge led to improved compliance with PPEs. Another study among maize farmers showed statistically significant associations ($P < 0.05$) between the knowledge and the attitudes ($r = 0.37$), the knowledge and the practices ($r = 0.24$), and the attitude and the practices ($r = 0.2$) [29].

However, not all studies indicated such relationship. In some settings, though the workers were knowledgeable about the harmful effects of the agents they worked with, yet this did not necessarily equate to increased utilization of the PPE. For instance in a study among workers involved in dyeing and printing, though all the workers were knowledgeable about hazards associated with the chemicals used in dyeing and printing, 66% of the workers did not wear gloves while working [30]. This is despite the fact that these workers may be aware that the chemicals used in dyeing can cause serious health hazard.

In terms of knowledge of workers about PPEs: a study has opined that poor knowledge also equated to poor utilization e.g. in a study on small scale industries in Al-Khobar, Saudi 9% of workers had no knowledge of any preventive measures and about 60% did not use any PPE [31].

Another study however observed that even with good knowledge of PPEs some workers still may not wear them e.g. in a study involving health workers though there was good knowledge of both the hazards and appropriate PPEs, utilization was not optimal; the main reason being the need to quickly take care of the patient [32].

Sir Thomas Legge fifth aphorism

“Attitude of the workers”: There is discrepancy between opinion of managers and those of workers in a national report in England. While 78% of construction workers claimed to always wear PPEs managers claim it is only 30% of workers that wear it [33]. Change of attitude towards utilization of PPEs may require continuous education and ergonomics since some staff are not aware of the health implications of default while others may find the PPEs as uncomfortable. The use of PPEs requires behavioural changes from the worker. It is the main weakness, since behavioural changes are difficult to achieve [34]. To maximize such changes, new workers should undergo induction training to inculcate good work habits and more experienced workers ought to receive regular refresher training to eliminate bad habits that might have developed [34].

Attitude of health workers who are expected to have good knowledge of these health hazards and also on how to use appropriate PPEs has been surprisingly poor. For instance among clinical healthcare workers,

usage of facemask was low (27%) in managing patients with respiratory symptoms but increased significantly to 71% when managing cases of suspected pertussis [35]. This may indicate their poor attitude towards PPEs since many wore it only when there was increased likelihood to hazard esp. during epidemics. Also even among critical care physicians there was suboptimal levels of influenza PPE adherence: only 63% of those surveyed were able to correctly identify adequate influenza PPE and 62% reported high adherence (>80%) with PPE use for the prevention of nosocomial infection. Findings indicated that factor which positively influenced the use of PPE in that study was likelihood of being reprimanded for non-adherence while reason for not wearing PPE was inconvenience [36]. Even in same occupation, workers may comply with some PPEs and not with other PPEs e.g. a study among surgeons showed high use of gloves (98%), gowns (83%) and facemasks (87%), but low use of eye protection masks (56%), and changing clothes (55%) when exiting and re-entering the operation department [37]. Above show convincing evidence that besides knowledge and availability of PPEs, attitude of the worker is a major determinant to utilization of PPEs.

Reasons for not wearing PPEs

Many reasons were identified for not wearing PPEs depending on the occupation and type of PPE. In a 3M personal protective equipment report of 2009 [33] those who wear PPE gave the following reasons: my boss tells me to wear it (21%), I could get sacked if I don't wear it (19%), I want to protect myself (85%), I want to go home after work (30%); I do not want to be ill when older (18%). From above two important reasons for compliance with PPE are fear of Managers and fear of ill-health from work hazards [33]. Salazar et al. in a study in the industrial sector in Washington State identified several factors for non use of respirators, the commonest of which are that it affected their communication and vision and also caused discomfort. Other determinants they identified were risk of exposure and efficacy of the PPE [38]. Geer et al. also observed similar reasons for non use of PPE for dermal exposure amongst industrial workers in the US [39]. In MacFarlane et al. study there was low use of respirator among farmers using pesticides in Australia [15] Indeed if farmers believed that the health risk was low they were less inclined to wear respirators [40]. In the health sector the main reasons for not wearing PPEs are emergency situations and interference of the PPE with patient care [41,42]. However, in some cases, the reason for not wearing it is non availability [12].

Conclusion

Findings suggest that knowledge of PPEs is poor in most occupations, there is negative attitude towards wearing some of the PPEs and the utilization is less than 50% in most cases. Education on hazards and PPEs have not always equated to improved use of PPEs. Responsibilities of the employers of labour like provision of PPEs, education of workers and enforcement of utilization of PPEs has been lacking. Even in some situations where the employer has done well in providing these PPEs some employers have defaulted in using these PPEs.

Recommendations to improve use of PPEs

The following suggestions were made to improve usage of PPE: make it more comfortable (44%), make it more stylish (20%), provide better training (29%), enforce it more strongly (43%), improve Health and Safety image (37%) [33].

There should be Standard Operating Procedures (SOPs) that include enforcement of PPEs. These SOPs should be pasted at conspicuous areas in the workplaces to serve as constant reminders to both employers and

employees. Monitoring of compliance to the use of PPEs should be reinforced and rewards should be given to those who comply.

Though education is important it should be targeted towards attitudinal change. Attitudinal change of both the employer and employee will improve utilization. Employers and employee should have the attitude of "safety first".

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