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Original Research Article

Laboratory- Safety and Security Concepts for Basrah University Students, Employers, and Teachers

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ABSTRACT

The aim of the present study was to assess the level of knowledge of the University students, employee, and Faculities in Basrah University about the laboratory - safety concepts and rules. A laboratory Safety test (built up by the researchers) had been applied on a sample consisting of more than 215 subjecs involved students, employee, and teachers of both sexes from colleges of Science , Education for Pure Sciences, Agriculture, Pharmacy, and scientific centers of Marine, Palm, and Polymers. The study is a descriptive analytical one in which data was collected using a questionnaire specially designed for this study. The prepared questionnaire is consists of different fields containing tens of statements arranged in two parts, the first covered the personality such as sex, qualification, age, and years of experience of subjects involved, the second part covered the skills of the subjects covered most of the expected knowledge, accidents, fires, quid lines, microbiological infectious, safety and security, mistakes, rules of research execution, applications of laws and constitutions, and training . The collection of data was prepared by using the stratified random sample whose participant number was exceeded (200) subjects with actual response rate of more than (60%). The results have revealed that the knowledge of students and employee about the laboratory safety ways were lower than that for members of staff in the university, and the overall knowledge about safety and security in the chemistry laboratories exceeded 80% of of the subjects involved within this study, this could be as a result of the comprehensive workshops arranged in most of the colleges of Basrah University.

Keyword: Safety; security; concepts; students; employee

INTRODUCTION

Recently an issue has been strongly emerged which concern the need to improve the culture around safety in our academic laboratories [1]. In the past few years, safety in academic laboratories has begun to move up the list of priorities. Not only organizations such as the Royal Society of Chemistry (RSC), the American Chemical Society (ACS) and the US National Research Council (NRC) are producing guidelines and reports on laboratory safety, but many US universities are implementing a raft of new safety measures in their laboratories. Unfortunately, the trigger for these developments was a couple of serious accidents that recently occurred in US chemistry laboratories [2]. The first occurred in 2008 in the laboratory of Patrick Harran, a chemist at the University of California, Los Angeles (UCLA), where research assistant Sheharbano Sangji was seriously burned while working with *t*-butyl lithium, which ignites on contact with air. She subsequently died from her injuries. Sangji was working on her own in the laboratory and was not wearing protective clothing. The second accident occurred in 2010 at Texas Tech. University in Lubbock, when graduate researcher Preston Brown was preparing a novel explosive material, a nickel hydrazine perchlorate derivative, in the laboratory of chemist Louisa Hope-Weeks. While breaking up clumps of this material with a pestle, it exploded; Brown lost three fingers, suffered burns to his face and hands, and damaged an eye.

Scientist may have a false sense of security about the safety of their laboratories. Most of the workers in the academic laboratories believe that their labs are safe place to conduct their jobs. Although, most of them believe that their labs are perfect, some are exposed to certain injuries by broken glasses and chemical inhalation while some are working frequently lonely with insufficient safety training [1]. Moreover, risk could reach a state of death, as what happened in one of the chemistry labs in Yale University when a young student was dead [3].

In chemistry laboratories, most of the chemicals produced and used today are beneficial, but some also have the potential to damage human health, the environment, and public toward chemical enterprises. As the leader of any institution, one must be aware of the potential for the accidental misuse of chemicals, as well as their intentional misuse. Laboratories face a number of threats, including the theft of sensitive information, high-value equipment, or dual-use chemicals that may be employed for weapons or illicit drug production. Chemical safety and security can mitigate these risks.

Yet the overwhelming majority of respondents asserted that their laboratories were safe places to work, that they had received sufficient safety training to minimize injury and that appropriate safety measures had been taken to protect employees. This level of comfort is similar to what has found in different surveys [4].

Working alone is certainly a problem but many of us work in circumstances where if we don't work alone we don't work at all. It is just not realistic to expect every chemist to be part of a huge research team where there can always be several people in the laboratories. Some of us are not funded to that extent so we work as best we can with what we have.

Depending upon our experience we noted that repeated safety and training exercises are proven to be successful. Safety routine is a formatting and generally best applied when refreshed and rehashed regularly.

In a 2012 survey of safety in US academic laboratories commissioned by the University of California Center for Laboratory Safety, 86% of around 2400 researchers who responded said they believed their laboratories were safe places to work. Now, that all sounds fairly positive, but dig a bit further into the figures and the picture looks less rosy [5].

For a start, senior researchers, who are responsible for ensuring laboratory safety, tend to be more confident about the safety of their laboratories than junior researchers, who actually spend most time in the laboratory. While 94% of senior researchers felt that appropriate safety measures were in place in their laboratories, only 69% of junior researchers agreed.

This survey provides a complete review of safety for laboratories handling specially the hazardous chemicals. It covers the safe use of key related laboratory equipment. While the discussion is aimed at laboratory scale, it introduces wider process safety management concepts such as toxicity and toxic levels, flammability and flammable parameters, use of safety data sheets, job safety analysis, risk levels, bio-safety levels, and fire and explosion prevention. Laboratory specific items such as inspections, personal protective equipment, hazard material storage, and waste disposal are also fully covered.

METHODOLOGY

Samples of study

The study samples represent a slice of people working in the chemical laboratories in University of Basrah covered Staff (teachers), students, and technicions (employee), sum of 215 during the second tearm of the year 2015-2016 covered Colleges of Science, Agriculture, Pharmacy, Education for Pure Science, Veterinary, as well as Scientific Centers of Marine, Polymers, and Palms.

Tool for the study

The study has been conducted by adopting a questioner set by the group of researchers. The questioner characterized by two parts, the first represented the personal parameters of the sampling subjects, Sex, Qualification, Age, and Years of Experience.

The 215 subjects within this study were represented by 115 (59.3%) males and 87 (40.7%) females as shown in figure 1 a, qualifications for subjects were set as follows: academics 110 Ph.D. holders 110 (51.2%); M.Sc. 66(30.7%), B.Sc. 19 (8.8%), students, undergraduate 13 (6%) and postgraduate 7 (3.3%), as shown in figure 1 b. Their age were including 16 (<25 years,7.7%), 20 (25-35 years 9.7%), 107 (36-45,51.7%), 45 (46-55 years,21.7%), and 19 (>55 years,9.2%) as shown in figure 1 c. Experience for subjects were ranged as follows: 27 (<5years,12.9%), 24 (5-10 years 11.5%), 97 (11-20 years 46.4%), and 61 (>20 years 29.2%)as shown in figure 1 d.

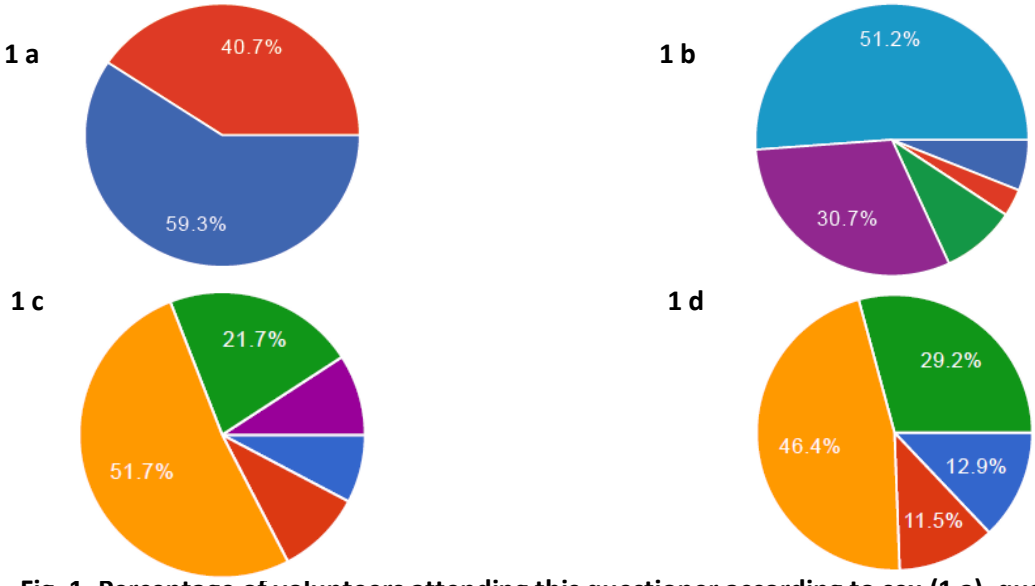

Fig. 1. Percentage of volunteers attending this questioner according to sex (1 a), qualifications (1 b), age (1 c), and experience period (1 d).

The second part of the questioner represented the skills of the volunteers covering most of the expected knowledge, accidents, fires, quid lines, microbiological infectious, safety and security, mistakes, rules of research execution, applications of laws and constitutions, and training. To measure the response of the volunteers, the pentagonal standard measure of Legart was used according to the table below

Response	Strongly refuse	Refuse	Neutral	agree	Accept
Degree	1	2	3	4	5
Relative weight %	20	40	60	80	100

Set of questions were employed to evaluate the safety rules for chemical laboratories users within the University of Basrah. The survey which covered 215 volunteers most express their feelings faithfully and showed differences among slices of people according to knowledge, experience, and durations.

Question 1. To what extent lab users accept suitable knowledge for lab security?, the answer was lab supervisors 48 (22.4%), personal education 59 (27.6%), relatives 1 (0.5%), official syllabuses 20 (9.3%), and all of those 86 (40.2%) as shown in figure 2 a.

Question 2. Did you exposed to any infections during your work in the lab? The answers were: burns 10 (4.7%), skin infection 19 (9%), nose, ear, and throat infection 30 (14.2%), poisons 11(5.2%), and none 142(67%) as shown in figure 2 b.

Question 3. Do you use microbial cultures with cautions?, the answers were: Yes 135 (66.8%), No 25 (12.4), and to a certain limit 42 (20.8%) as shown in figure 2 c.

Question 4. Is there any supervised committee for chemical, biological, and radiation safety and security in the University of Basrah? The answers were Yes 111 (52.6%), and No 100(47.4%). As shown in figure 2 d. This approach due to the recent establishment of this committee in the University.

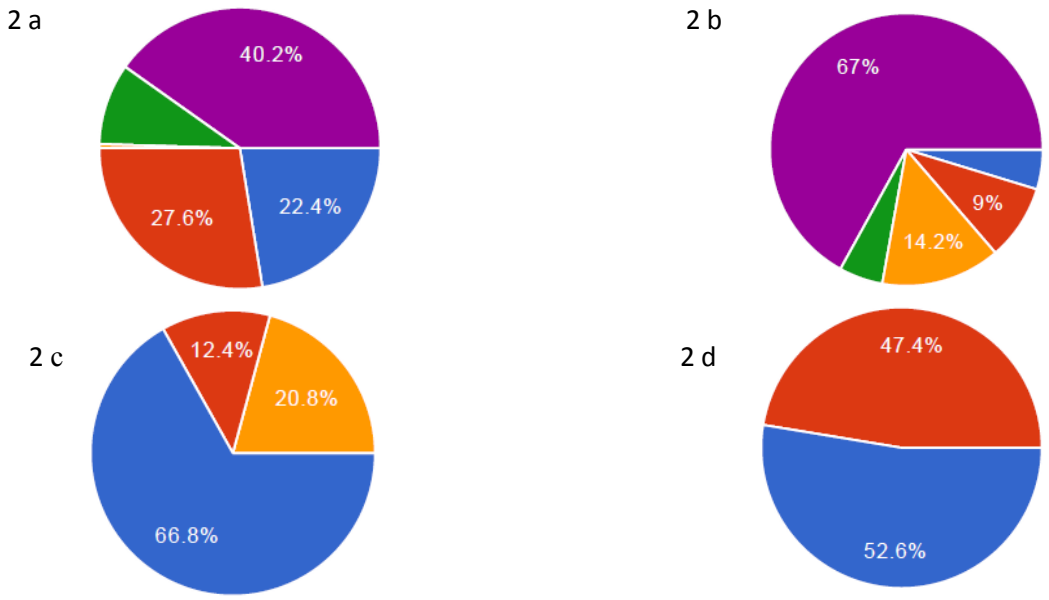

Fig.2. Some aspects of the subjects in this study

Question 5. What are the difficulties that researchers facing in the laboratory?. The answers were shortage of instruments and tools 48 (22.3%), the use of inconvenient 2 (0.9%), unsafe tools and instruments 43 (20%), lower knowledge for students about risks 9 (4.2%), and all above 113 (52.6%) as shown in figure 3 a.

Question 6. In the laboratory, are you interested in applying and follow the directions for safety?. Two answers were received, Yes 205 (96.2%) and No 8 (3.8%), as shown in figure3 b.

Question 7. Do you inform the laboratory supervisor when you make a mistakes while using chemicals? The answers were Yes 183 (88.8%), and No 23 (11.2%), as shown in f igure 3 c.

Question 8. Do you receive any safety directions before performing the experiment?. The answers were Yes 150 (72.5%), and No 57 (27.5%), as shown in figure 3 d.

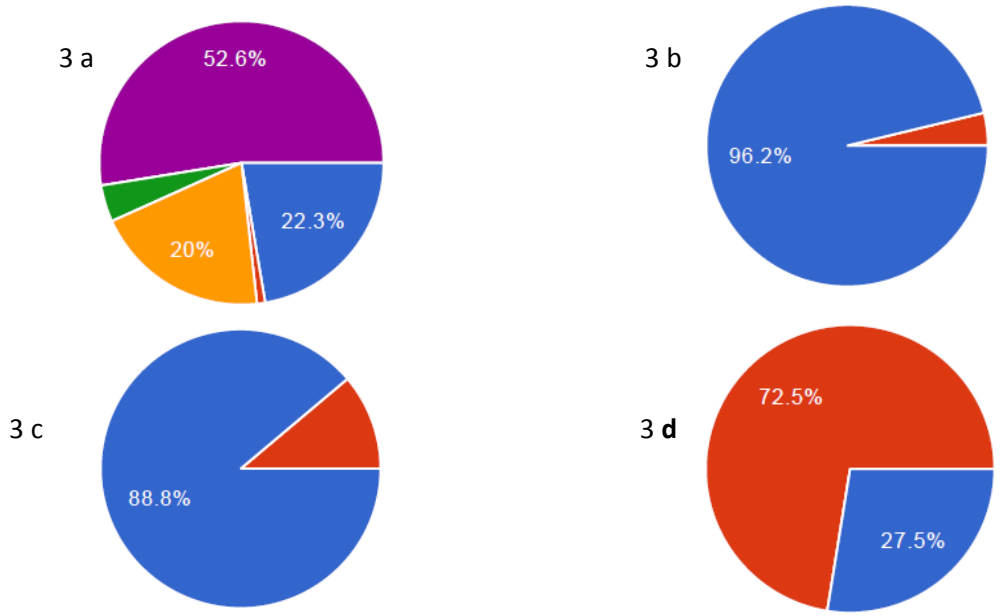

Fig.3. Some other aspects for the subjects in this study

Question 9. Do you afraid conducting experiments alone in the laboratory without existing of the supervisor? The answers were, always 96 (45.9%), sometimes 92 (44%), and never 21 (10%), as shown in figure 4 a.

Question 10. Dose laboratory supervisor conduct dangerous experiments? The answers were always 58 (28%), sometimes 104 (50.2%), and never 45 (21.7%), as shown in figure 4 b.

Question 11. What are the most common accidents happened in the chemical laboratories? The answers were suffocation 83 (40.1%), burns 67 (32.4), wounds 33 (15.9%), and fires 24 (11.6%), as shown in figure 4 c.

Question 12. What is the extent of your knowledge in using fire extinguisher? The answers were, excellent 24 (11.2%), good 101 (47.2%), and weak 89 (41.6%), as shown in figure 4 d.

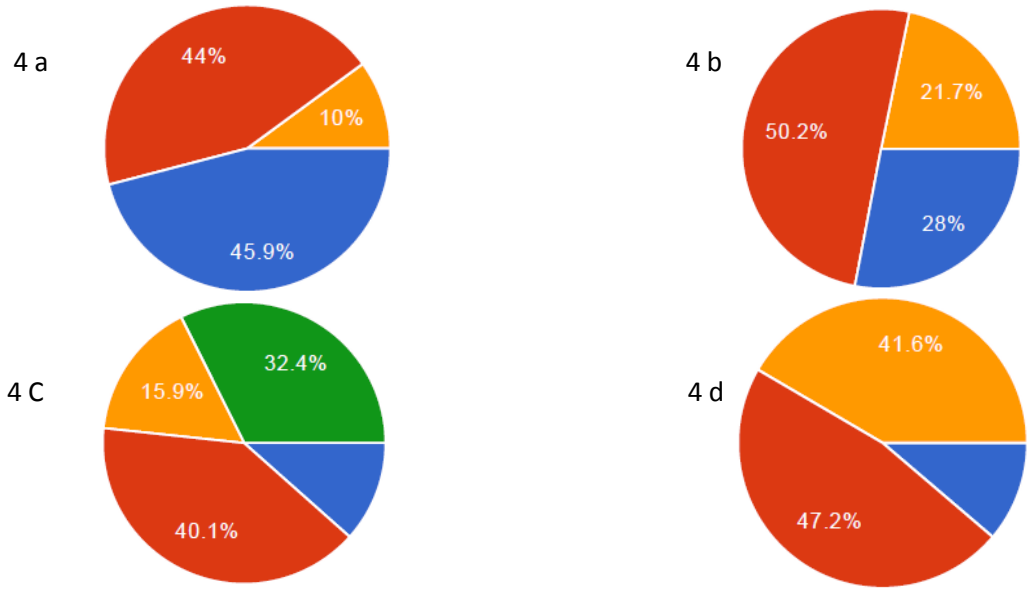

Fig. 4. Some other aspects for the subjects in this study

Question 13. Are well familiar with the risk of chemicals to be used in the lab? The answers were, Yes 147 (68.7%), No 9 (4.2%), and to a certain extent 58 (27.1%). As shown in figure 5 a.

Question 14. Does the laboratory supervisor conserve the cleaning of the lab?. The answers were, Yes 114 (53.3%), to a certain extent 77 (36%), neutral 20 (9.3%), No 2(0.9%), and never 1 (0.5%) as shown in figure 5 b.

Question 15. Do you prefer presence of more than one exit in each lab? The answers were Yes 67 (31.5%), to a certain extent 98 (46%), neutral 18 (8.5%), No 22 (10.3%). and never 8 (3.8%), as shown in figure 5 c.

Question 16. Does the emergency plans and first aids are necessary or not? The answers were, Yes 80 (37.9%), to a certain extent 67 (31.8%), neutral 33 (15.6%), No 25 (11.8%), and never 6 (2.8%), as shown in figure 5 d.

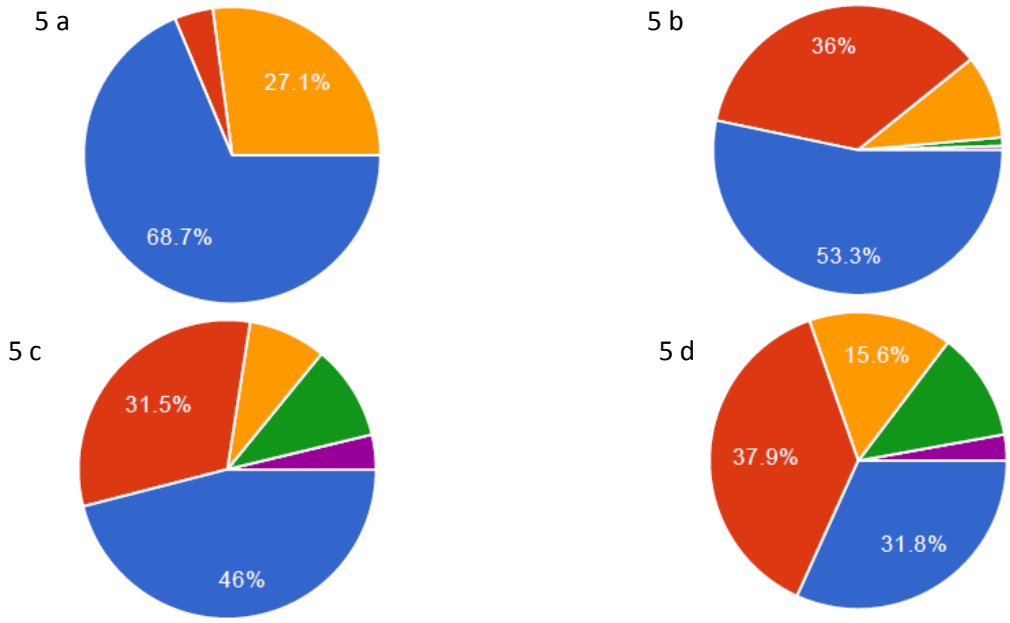

Fig. 5. Some other aspects for the subjects in this study

Question 17. Do you prefer training for safety by practical application, lectures, or workshops? the answers were Yes 104 (49.5%), to a certain extent 82 (39%), Neutral 15 (7.1%), No 6 (2.9%) , and never 3 (1.4%) as shown in figure 6 a.

Question 18.Does the most common reason in injuries and accidents was the rejection or lower knowledge in application of safety and security percussions?, the answers were Yes 103 (48.6%), to a certain extent 87 (41%), neutral 13 (6.1 %), No 8 (3.8%), never 1 (0.5%), as shown in figure 6 b.

Question 19. Is their any safety equipment's such as fire , fire alarm, water shower for eyes, and first aid pharmacy in the lab?, the answers were Yes 100 (46.9%), to a certain extent 62 (29.1%), neutral 18 (8.5%), No, 17 (8%), and never 16(7.5%), as shown in figure 6 c.

Question 20. Is their any ventilation and enough lighting in the lab? The answers were Yes 113 (53.6%), to a certain extent 66 (31.3%), neutral 16 (7.6), No 12 (5.7%), and Never 4 (1.9%), as shown in figure 6 d.

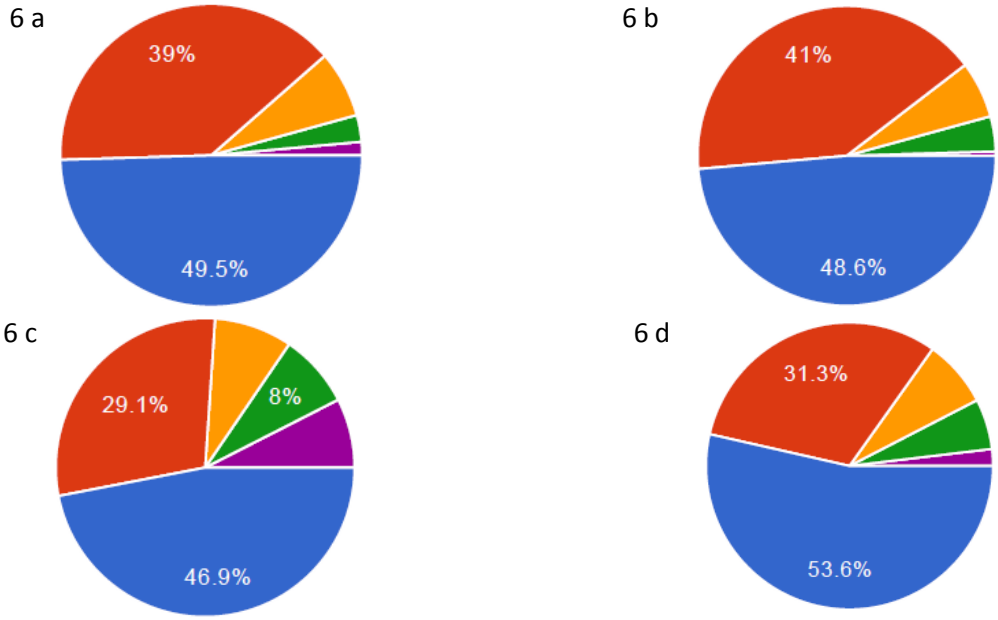

Fig. 6. Some other aspects for the volunteers in this study

Question21. Does the lab good place for play, fun, and eating?, the answers were Never 164 (76.6%), No 46 (21.5%), neutral 2 (0.9%), to a certain extent 2 (0.5%), and Yes 1 (0.5%), as shown in figure 7 a

Question 22. To identify chemical material do you use touch, smell, or test?, the answers were Never 153 (71.5%), No 48 (22.4%), neutral 6 (2.8%), to a certain extent 5 (2.3%), and Yes 2 (0.9%), as shown in figure 7 b.

Question 23. Do you recommend a medical test and a record for all users of the chemical labs?, the answers were strongly recommended 60 (28.8%), recommended 50 (24%), neutral 35 (16.8%), refuse 34 (16.3%), and strongly refused 29 (13.9%). As shown in figure 7 c.

Question 24. Do you support application of systems and laws specialist for safety and security in the chemical labs?, the answers were strongly recommended 61 (29.3%), recommended 73 (35.1%), neutral 38 (18.3%), refuse 26 (12.5%), and strongly refused 10 (4.8%). As shown in figure 7 d.

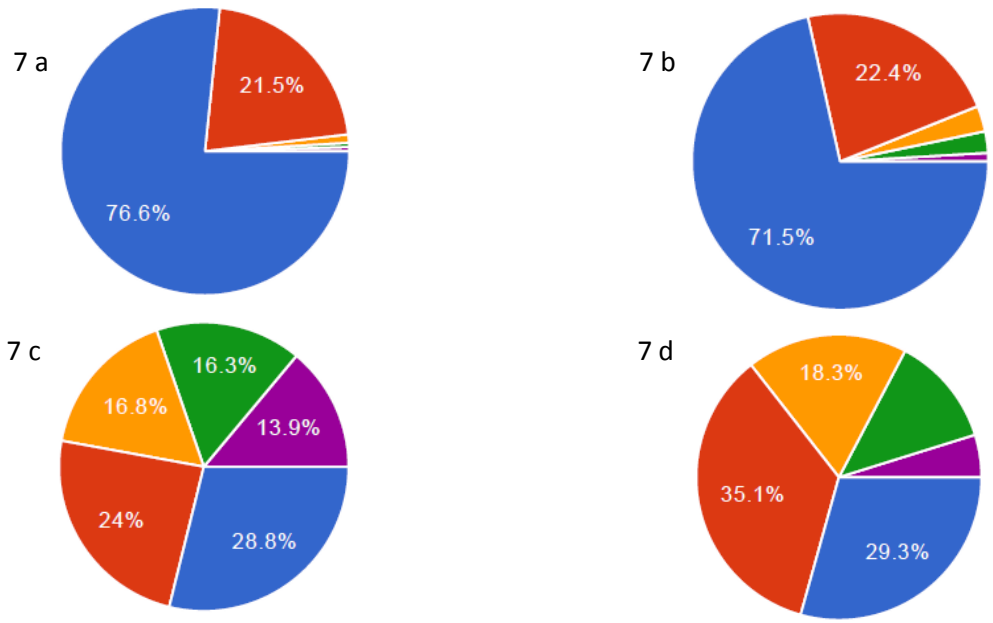

Fig. 7. Some other aspects for the volunteers in this study

DISCUSSION

There were no differences between both sexes involved within this study, they behave close to each other and they have equally knowledge about lab safety rules [6]. Lack of informations by volunteers involved within this study means that some did not receive adequate training about how to use the means and tools of occupational safety, this will evolve the need to create a specialized unit to design and follow up the occupational safety [7].

According to question 11 it seems that most of the expected accidents took place in the labs were mainly the suffocation, burns in a trend as follows:

Suffocation > burns > wounds > fires

Very rare persons were not familiar with the risks of the chemical materials due to their background which means that they never attend a chemical laboratories. Lab supervisors have a great attitude in their labs to be clean always, only at a certain occasions during the holidays and stoppages of study.

CONCLUSION

The University of Basrah has exert a great concern for importance and necessary for the security and safety inside the chemistry labs, many workshops were performed for treatment most of those who are in continuous touch with chemicals and laboratories

This questioner involved almost more than 24 questions which were too broad and unfocused to draw definite conclusion. The questioner represented by two parts, the first foucused upon the personal characterizations for the subjects involved in this survey, among which are the sex, qualification, age, and period of duty, while the second part has focused upon the skills of the subjects. According to most specific questions in this survey it is revealed that safety standards are often not adhered. For most of these questions more than 80% of subject involved were agreed with the safety and security in the chemical labs. Allthought some had received safety training on specific hazards or agents they worked with, and around half agreed that lab safety is very important, with chemists (50%) most likely to feel this.

One of the main conclusion by the survey was differences in attitudes to safety between those in junior roles (such as M.Sc. and PhD students) and those in more senior positions (such as professors, heads of department and principal

investigators). Around 70% of scientists said that supervisors are always aware of the safety culture in their own laboratories.

Therefore as a final conclusion for the situation of Basrah University:

1. More than 80% of subjects involved in this survey were agree in application of safety and security in the chemical laboratories.
2. Training workshops are very important for those who attend chemical laboratories whether they involve hazardous or none hazardous chemical compounds.
3. Most of subjects involved in this survey are quite familiar with most of equipment's exist in the laboratory, their places and how to use them.
4. Very few subjects were not familiar with the risks of the chemical compounds (they might never attend chemical laboratory)
5. Supervisors have a great attitude to be clean, tidy, well equipped, advice students not to touch hazardous chemical compounds or conduct dangerous experiment or work alone. Moreover, supervisors prefer documentation for accidents and problems.
6. Experience is very important seniors as professors, doctors and supervisors are different in their attitude towards safety compared with juniors as postgraduate Ph.D. and M.Sc. as well as undergraduate students.
7. Unfortunately there were no data at earlier time for comparison.
8. Basrah University has exert a great concern for importance and necessary for the security and safety in the chemical laboratories.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

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