Investigation on Radon Awareness among the General Public in Bahrain

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Abstract This study was designed to investigate the awareness regarding Radon awareness among Bahraini people. A total of 608, citizens were (598 people) 98.4% and (10 people) 1.6% foreign people were examined using a questionnaire that covered 16 questions of radon awareness identifying qualification, specialization, impacts, and solutions. The study included (290 Female) 47.7% and (318 Male) 52.3% of participants living in Bahrain, bilingual (English and Arabic). This survey was performed with the margin error $\pm 4\%$ point at a confidence level of 95 %. The sample size was then calculated and the size of 600 persons was obtained. The results have shown the radon awareness of Bahraini people is low and only 181 responses 29.8% are aware of radon is harmful and consider health hazards. Radon awareness level more increases among married Males and Female age 35-44.

1. Introduction

The Radon is often so-called the "silent death" because radon is an invisible gas odorless and tasteless with no instant health symptoms where originally comes from nuclear transformations of natural uranium (especially, U-238) from the ground only.

Radon is known to be the first cause of lung cancer among non-smokers, which makes it the second most important cause of cancer after smoking, however, the public knowledge about radon is greatly much unclear.

The radon exposure was found to be the number one most common cause of lung cancer for a non-smoker in the country such as the United States and breathing it over prolonged periods present a significant health risk to families all over the USA [1]. Therefore, safety regulations are in place and US EPA recommends that remedial measures be taken to reduce radon when levels greater than 150 Bq/m^3 (4 pCi/L) within the building are found [2].

In Bahrain, a few percentages of people with lung cancer are quite high and there are no measurements of radon levels. There is no research conducted in order to find a probability of causation for these high events of lung cancers and therefore make the safety level of radon in Bahrain.

It is therefore essential to measure the radon level in Bahrain in order to protect public health and help people to be aware of and reduce the incidence of lung cancer.

This paper, as one of a series of studies to suggest a safe level of radon in the Kingdom of Bahrain, is to investigate an overview of the awareness among Bahraini people in the Kingdom of Bahrain using survey. Since lung cancer is the most common cancer among Bahraini males of all cancers and the third most common in Bahraini females of all cancers [3], this research is thought to be able to play important role to educating Bahraini people about radon which can make installation of radon dosimeters in their residences in order to make radon national survey easier mission to conduct. Assuming the radon level is low, people of Bahrain still need to know radon level and educate in order to reduce any expected higher level indoor.

2. Methods and Results

The survey was targeting the general public it was designed containing bilingual questions (English – Arabic) as both languages widely used in the Kingdom of Bahrain. The survey was multiple choice questions and distributed electronically through a mobile application to male and female randomly without knowing their background qualifications previously. In order to determine the sample size in the survey for this study, the theoretical method based on z-test formula, i.e. $z = (x - \mu)\sqrt{n}/\sigma$ was used. With taking into account the margin error or a sampling error of $\pm 4\%$ point at a confidence level of 95% the sample size was then calculated and the size of 600 persons was obtained. The observed percentage of 50% (=0.5) was normally used to obtain the maximum sample error in this calculation [4].

Bahrain's population is 1581957 [5],
608 people living in Bahrain responded to the survey in 16 days. This number of people is greater than the required sample size.

Table 1. Question items for a survey of radon awareness of the general public in Bahrain.

Question items

1) Gender [Male – Female]
2) What is your age? [Under 18, 18-24, 25-34, 35-44, over 45]
3) What is your marital status?[Unmarried - Married]
4) If you are married, how many children do you have [No child 1 child, 2 children, 3 children, >4 children]
5) What's your nationality? [Bahraini – Non-Bahraini]
6) What is your qualification? [High Secondary School, Undergraduate, Graduate, Postgraduate]
7) What is your study specialization? [Humanities, Medical, Scientific, Other]
8) Do you know radon or have heard about it? [Yes, No]
9) What is radon (1)? [Electronic device, Natural material, Artificial material, I don't know]
10) What is radon (2)? [Gas, Liquid, Solid, I don't know]
11) Is radon? [Active, Inactive, Radioactive, I don't know]
12) Is radon? [Colorless, Odorless, Tasteless, I don't know]
13) Where does radon come from? [Underground, Water, Air, I don't know]
14) Is radon harmful? [Yes, No, maybe, I don't know]
15) Is radon useful? [Yes, No, maybe, I don't know]
16) If radon is harmful or useful, wherein the body? [Head, Chest, Abdomen, I don't know]

We encounter obstacles with the first platform as the company stopped after having 100 participants because they asked for payments and it was not clear from the beginning, so all results were excluded, the second platform was easier and more friendly so we use it for this research.[6]

The questions were related to radon awareness among people in Bahrain of various educational backgrounds and it contains 16 questions as listed in Table 1.

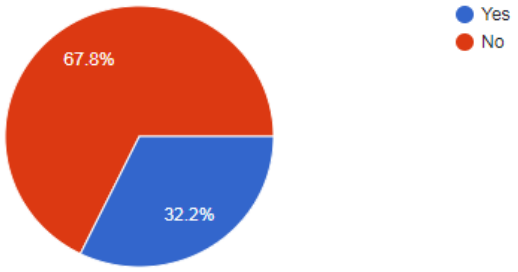
The questions divided firstly to general questions as gender, age, marital status number of kids, Bahraini or non-Bahraini and their qualifications in order we can distinguish the male and female and know who has awareness among ages.

Secondly to more specific to the radon in order to know the level of awareness of the radon physically and from where it comes from, in which part of the body can effect.

3. Results and Discussion

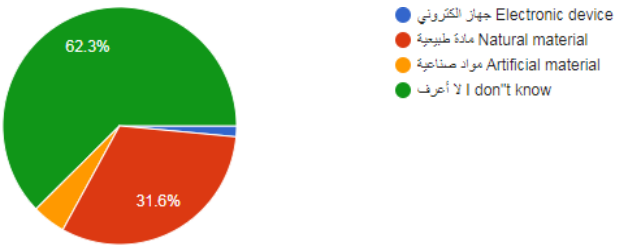
Participants with higher education know more to get answers correctly, for the question "Do you know Radon or have heard about it?" in figure 1 shows 196 responses answered yes (32.2%) and 412 responses (67.8%) answered did not hear about it.

Figure 1. Percentage of those know about Radon



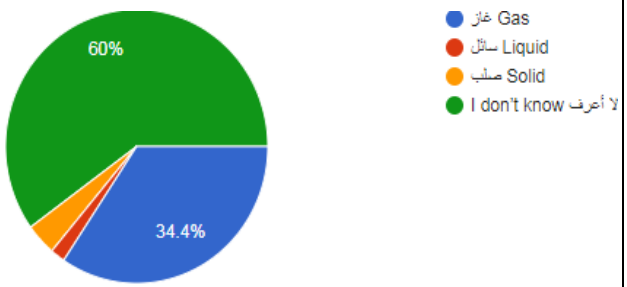
Participants were asked in Figure 2 if radon natural material, artificial material, electronic device or they don't know in order to investigate the knowledge of radon characteristics, and then the results showed 62.3% 379 participants answered they don't know, 31.6% 192 participants answered it is naturally occurring radioactive material, 4.6% (28 participants) that Radon is Artificial material and 1.5% (9 participants) said it is Electronic device.

Figure 2. What is Radon?



In Figure 3, the similar question was asked if radon is gas, liquid, solid or they don't know, and results showed the majority of participants answered "don't know" 60% 365 responses, in the other hand were only 34.4% 209 responses answered correctly it is a gas. Miner answers answered 3.8% 23 responses answered Radon is solid and 1.8% 11 responses said Radon is Liquid

Figure 3. Is Radon?



The majority of participants 79.9% (486 responses) answered wrong about the characteristics of radon and 20.1% (122 responses) answered that radon is colorless, odorless and tasteless as shown in Figure 4 regarding if the radon is colorless, odorless or/and tasteless.

Figure 4. Radon Characteristics

For question investigating an awareness of health hazards of radon, the Table 2 below shows majority of 79.9% did not know, the question was "If Radon is harmful or useful, wherein the body will effect?"

Table 2. The results of the hazard awareness of radon in the body.

Head	Chest	Abdomen	I don't know
41 (6.7%)	122 (20.1%)	8 (1.3%)	437 (71.9%)

4. Conclusions

Broadly, the radon awareness level to the Bahraini people is low, only 32.6% are aware of radon and its health hazards. Radon awareness level among Unmarried people between ages 18-24 was highest, and among married people between the ages, 35-44 were the highest. This research results will be able to let the policymakers and environmental advocates open the door, while the finding of technical matters will be benefited to environmental scientists and engineers. Related authorities in the government of Bahrain like The Supreme Council for Environment make more effort to take measurements of level of radon and set national reference levels as an aid to optimization of protection against radon exposure, on the other hand Ministry of Information boost the radon awareness should be made by the concern authorities to enhance radon awareness scale in the nation employ technologies and accounts in social media to cover bigger number. And hope to be more studies in the future about the level of radon concentration distribution, the effect of it to the general public and establish regulation or recommendation of radon in Bahrain.

5. References

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