

ABSTRACT

INTRODUCTION

Pre-employment chest X-Ray is common test used in medical check-up that every job seeker must undergo as a recruitment requirement. There are many studies proven the usefulness of this test. However, the huge quantitatively of this test – for example in 2019 more than 12 Million exam were performed in KSA were this study is conducted – suggests re-assessment of the feasibility of this procedure as an objective of our study taking in consideration time consuming, cost effective and radiation dose.

METHOD

This is a retrospective study that reviewed the pre-employment chest X-Ray performed in PSMMC for the period from October 2018 to May 2019. The data were extracted including age, gender and chest X-Ray reports and the data were analyzed.

RESULTS

We reviewed data of 10,000 chest X-Rays. **233 female Saudis and 8558 male Saudis.**

- **The mean age of non-Saudis** is 33 ± 5 and age range from 22 to 45 years.
- **The mean age of female Saudis** is 26 ± 5 and age range from 18 to 35 years.
- **The mean age of male Saudis** is 21 ± 5 and age range from 18 to 40 years.

*Only one candidate failed in the test of pre-employment chest X-Ray out of the 10,000.

CONCLUSION

Pre-employment chest X-Ray should be no longer a routine exam in pre-employment medical check-up and should be limited for job seekers older than 30 years old.

INTRODUCTION

Pre-employment chest X-Ray is a common investigation used in medical check-up. Which is required by many institutions worldwide that applicant must undergo before recruitment or enrolment. This investigation is an old test as old as the X-Ray machine was used. It has a great value in showing the applicant medical fitness assessment as it shows the shape of rib cage, many lung pathologies e.g. T.B(Tuberculosis), some cardiac pathologies and deformities in spine etc. [1,2,3]

In a developmental center, a pre-employment chest x-ray was required for all job applicants. We scrutinized the pros and cons of this practice through a review of the medical literature and our experience, and discussion with our colleagues. We concluded that such chest x-ray caused unwarranted radiation exposure, did not produce compliance with the tuberculosis laws, gave a false sense of security regarding workers' compensation risk management, was contrary to established occupational medicine practice guidelines, and was unnecessary and wasteful. We discontinued such chest x-rays. The purpose of the pre-employment examination should remain narrowly job related. Even long-established procedures require periodic utilization review. Successful completion of the pre-employment examination is usually a prerequisite for employment. Therefore, it is crucial that this examination is job specific, and its scope is limited to its stated objectives. [4,5,6]

Pre-employment chest X-Ray is performed in X-Ray department where the patient (New Employee) is asked to undress his/her chest area and wear a special gown. The patient then is positioned against the Bucky (Image Receptor) that's hold either a radiographic film or digital image receptor. The X-Ray tube is

used to produce X-Ray radiation usually range 100-120Kvp and 5-8mAs. After exposure is made the image is processed and transfer to the radiologist for interpretation.[7,8,9]

Almost every employee in the worldwide underwent pre-employment chest X-Ray e.g. as per the Saudi General Authority for statistics that around 12.8 million employee persons start their work in first quarter in 2019. These employees definitely underwent a pre-employment chest X-Ray.[8,10,11]

This huge number of exposures has certain cost and consume time for the government, institutions and hospitals beside the applicant radiation dose.[12]

In this study we are reviewing the feasibility of this huge number of exposures by analyzing the finding of 10000 pre-employment chest X-Ray roughly, this test costs around 600 million SR this year in this country. It is wise to assess the feasibility and efficacy of this test and in this test. [11]

LITERATURE SURVEY

Some published studies have shown negative results. If they are looking for diseases such as TB (Tuberculosis) or lung cancer the radiation is not enough and needs more accurate tests such as CT scans. But they are expensive and some found that TB (Tuberculosis) testing with PPD (Purified Protein Derivative) was enough if the test result was negative. Some studies in developed countries have found that reviewing post-employment examinations is necessary for people with special needs.

An article about The futility of universal pre-employment chest radiographs. [8], In these articles the author pointed goal of a landmark federal legislation was to increase employment opportunities for people with disabilities and this act led to a dramatic change in the role and scope of pre-employment examinations.

According to California law requires TB (Tuberculosis) is screening for employment in healthcare facilities. NO CXR IS REQUIRED. The examination must include a tuberculin skin test, and for tuberculin reactors, a CXR within 90 days before or 7 days after the start of employment.

An article about Chest X-Ray: An unfair screening tool. [12], In this article the author descriptive study 3 years period. In Pakistan in 2019 the author not specified the gender of samples. According to The World Health Organization (WHO) estimates that half of all radiological procedures performed worldwide are CXR. From the review of the past literature it has been observed that CXRs on individuals without cardiopulmonary disease has not been shown to improve disease outcome and is not cost-effective. In addition, many things seen on CXR turn out to be artifacts or benign problems. Even many insurance companies

no longer pay for these “routine” X-Rays obtained in the absence of specific signs, symptoms or medical conditions. According to the latest study also, universal chest radiography in a large pre-employment TB screening program was of low yield in the detection of active TB and it provided no assistance in deciding which individuals to prioritize for treatment. The fact that routine pre-employment CXR gave false sense of security and is of little value is thus well established. The author finding in the CXR for confirming or ruling out pulmonary related diseases could be inconclusive, to say the least, denying employment opportunities merely on the basis of inconclusive evidence therefore, seems manifestly unjust. Conversely, declaring examinees free from pulmonary diseases merely on this basis is also improper and it is unfair for employ to loss chance of jobs because of CXR. It is depending on the life style of contrary, the environment life and health.

An article about Contact tracing/pre-employment screening for pulmonary tuberculosis: Should positive mantoux test necessitates routine chest X-Ray?. [16], CXR VS Mantoux test PPD (Purified protein derivative). The author specified the gender of the samples which is makes better result (48 female and 52 male). In this study the author compare the tuberculosis with the new pre-employment which in my case is not effective because we study the necessary pre-employment CXR. The good thing in these articles is we can concede the use of PPD (Purified protein derivative) as alternative of the CXR procedure.

An article about Pre-employment chest radiography and NHS staff. [10], In this article the author pointed there are 640 new employees during one year had chest radiography. No cases of TB (Tuberculosis) were detected. Which is meaning the CXR exam, and it is just ROUTINE. Most cases have symptoms, instead of being detected in routine annual radiography.

The pre-employment health check should include questions about the symptoms it suggests. Tuberculosis, including persistent coughing, unwarranted weight loss, bad mood, and night sweats. Further more radiology should be reserved for people with symptoms. This will save time and money and avoid unnecessary radiation for healthy people.

An article about Screening for pulmonary tuberculosis using chest radiography in new employees in an industrial park in Taiwan. [3], This study is conducted in Taiwan to compare the Pre-employment TB (Tuberculosis) screening with The National TB Surveillance program in Taiwan. The author found the active Surveillance program throw mandatory screening was much higher than of The National TB (Tuberculosis) Surveillance program. The result of the study is high-lighted the need for more active Surveillance effort in Taiwan and for both men and women. However, whereas our program had similar yields between the 2 sexes, The National TB Surveillance program had more than 2 fold higher yield for men as compared with women.

PROJECT OBJECTIVES

This study aims to evaluate new employees to minimize the potential adverse effects of X-RAY in this work, to emphasize the fact that chest x-rays are not necessary for pre-employment testing and that use of their use is limited to the current condition, and we will publish the data of our medical center observed during the past years.

MATERIALS AND METHODS

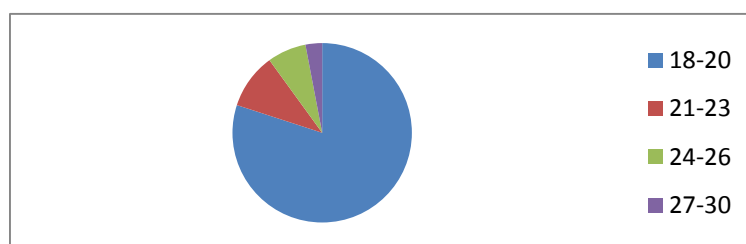
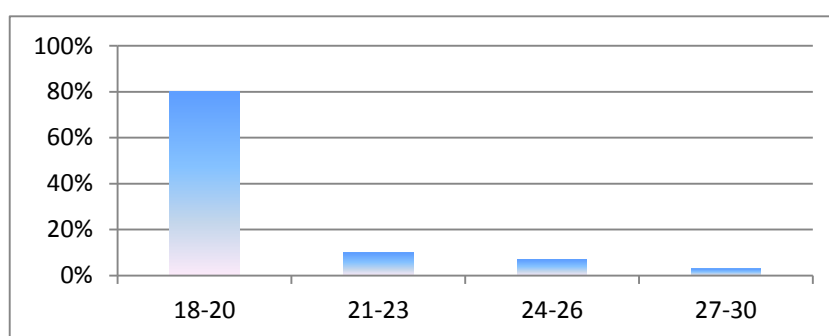
This study was a retrospective review of the reports of chest radiographs and data analysis conducted between October 2018 to May 2019. Retrospective review of reports of routine. Chest radiographs in PACS system was done. The medical records' number of all who underwent a pre-employment medical check-up was collected and reports of chest radiographs were reviewed. Data was entered into spreadsheets under various sub-headings. All abnormalities were recorded irrespective of the severity or the effect of the abnormality on the employment of the individual. It is worth mentioning that the cost of these rays is expensive as Dallah Hospital 186 SAR, Al-Habib Hospital 208 SAR, Al-Hammadi Hospital 145 SAR, The medical specialty 140 SAR and Al-Mshari 197 SAR.

RESULTS

A total of 10,000 individuals were finally included in the study. The age range was from 18 to 45 years with an average age of 35 years, with nearly equal representation from both genders. The data represented different strata of society as they were for vacancies in all cadres (from housekeeping staff to highly specialized doctors).

Candidates are categorized to the following group ages:-

Age of the candidates (years)	Percentage value (%)
18-20	10
21-23	80
24-26	7
27-30	3



Figures1: Age distribution of the candidate participated in the study.

The total number of abnormalities was 634. The abnormalities were categorized as E.N.T, general surgery, laboratory, internal medicine, Ophthalmology and psychological as presented in the table.

Category	Number
Nose, Ear and Throat (E.N.T)	15
General Surgery	122
Laboratory	85
Internal Medicine	68
Ophthalmology	343
Psychological	1

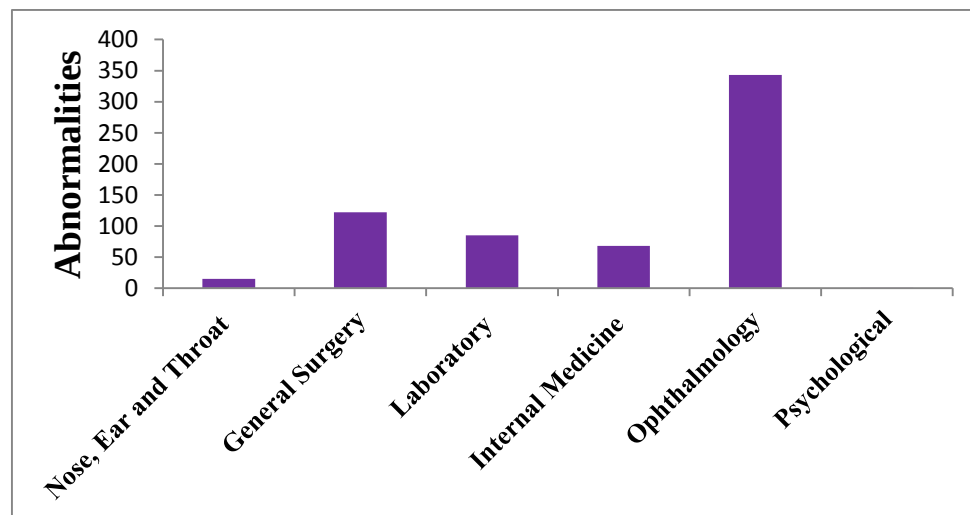


Figure 2: Kinds of abnormalities E.N.T, general surgery, laboratory, internal medicine, Ophthalmology and psychological covered in the study.

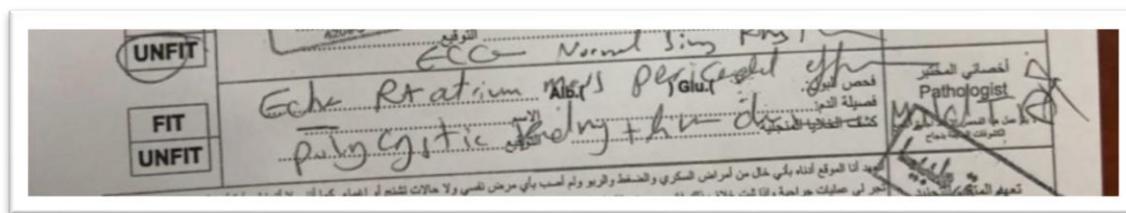


Image of Report inappropriate scans

*ONLY one candidate failed **The Pre-employment chest X-Ray** which represent $1/10,000 = ,0001\%$.

*The candidates gender is as following:-

Gender	Percentage
Male	79%
female	21%

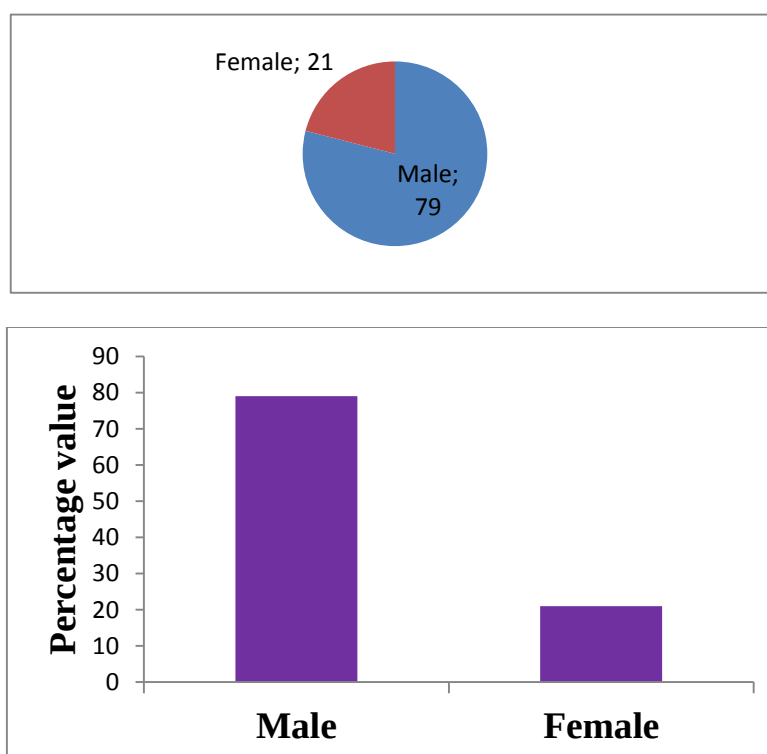


Figure 3 : Shows percentage of male and female candidates in the present study

Saudi vs. None Saudi

Title	Number
Saudi	643
None Saudi	1209

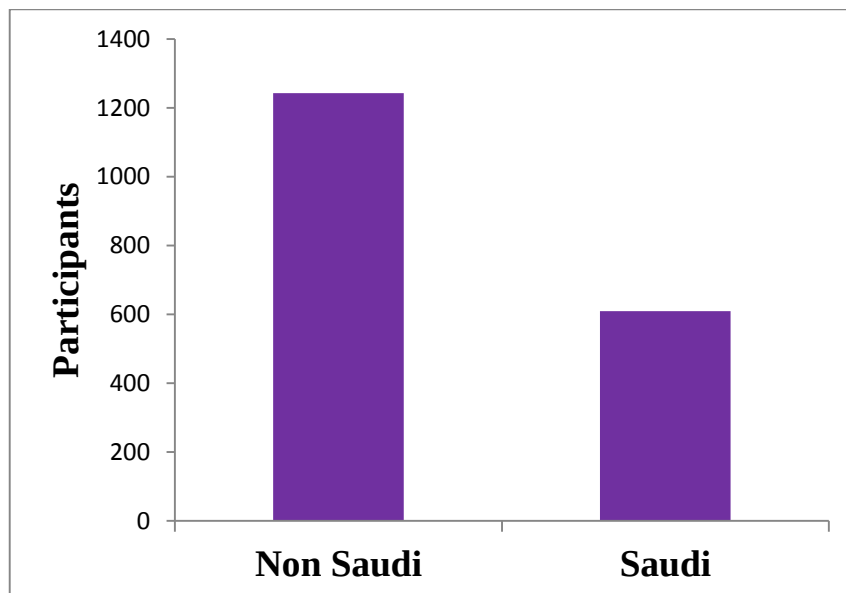
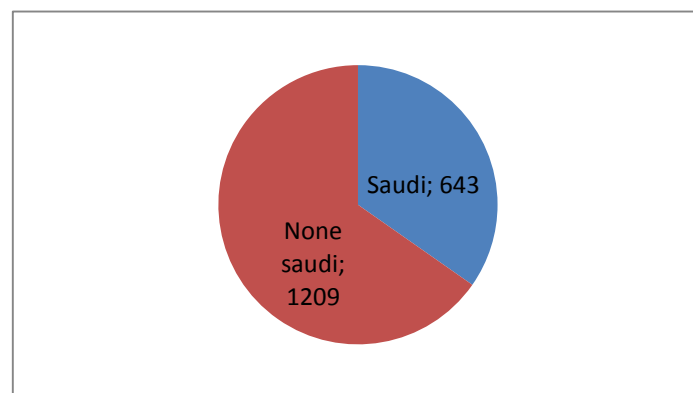


Figure 4: Shows number of Saudis and non-Saudi participated in this the study.

Military vs. Civilian

Title	Number
Military	1852
civilian	8148

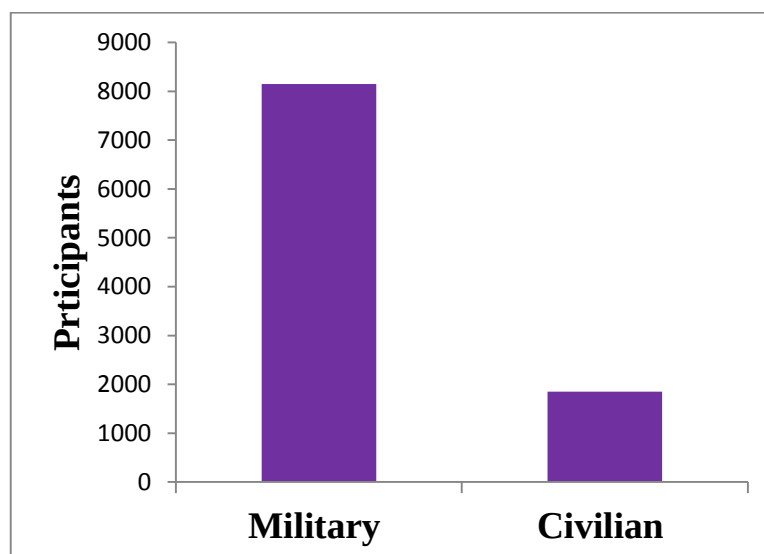
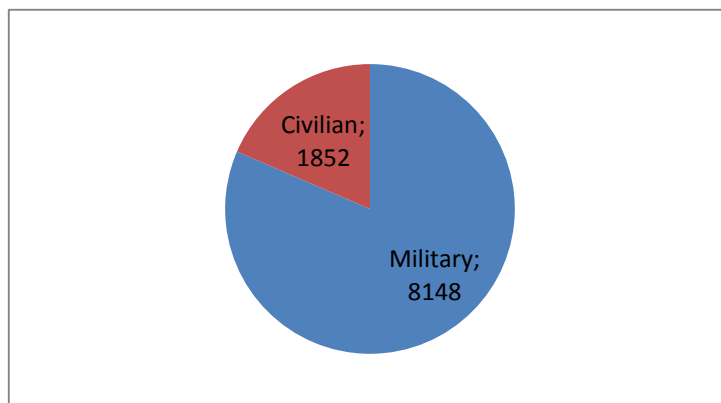


Figure 5: Shows the number of military personal and civilians participated in this study.

Fit vs. Unfit [9],

Title	Percentage
Fit	98.8%
Unfit	5.2%

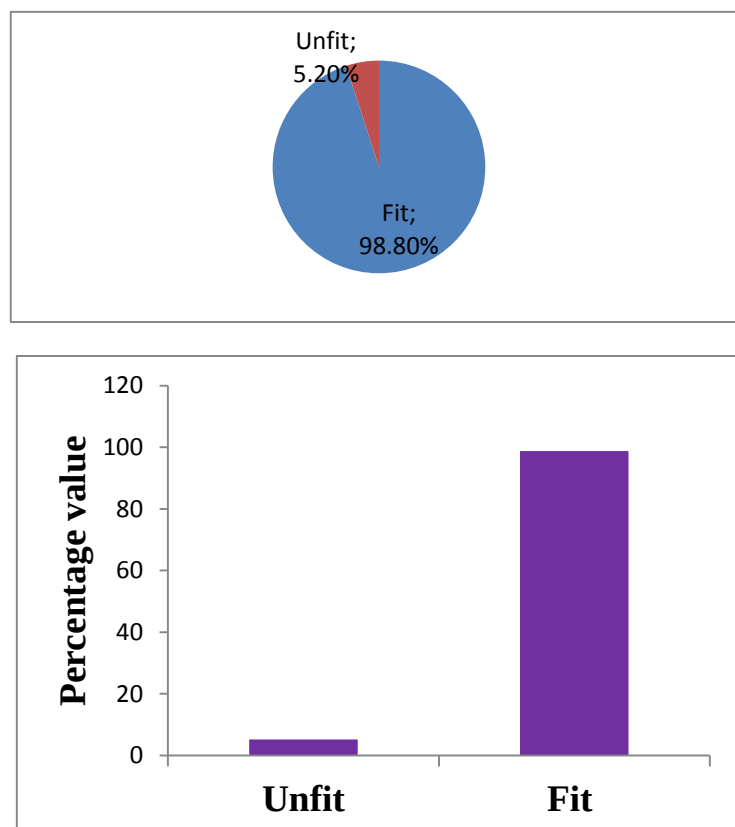


Figure 6 : Shows the percentage of unfit and fit participants in the study.

Therefore, chest radiography should be restricted to individuals with clinical findings suggestive of cardio-thoracic disorders during pre-employment medical screening.

DISCUSSION

Although only one candidate from the 10000 group failed the P.E.C. However, among the 10000 candidate 634 failed in other test ex. Ophthalmology, ENT, General surgery, etc.

The non-Saudi workers (1209) who underwent pre-employment chest X-Ray -Iqama checkup- already had a medical checkup in their countries and they also may have chest X-Ray as a part of their medical checkup.

The cost of the X-ray used in the samples was approximately 1752,000 SR, which is a large cost for the institute, and in the end the positive sample was only one person.

A questionnaire was conducted by 6 people of different nationalities and the answers were all to confirm that they had previously conducted the examination in their countries.

Questionnaire

What is the percentage of the following age groups among medical checkup candidates:-

5 people were asked and the results were:

Age	Percentage
18-20	80%
21-23	10%
24-26	7%
27-30	3%

The results from the 1st candidate.

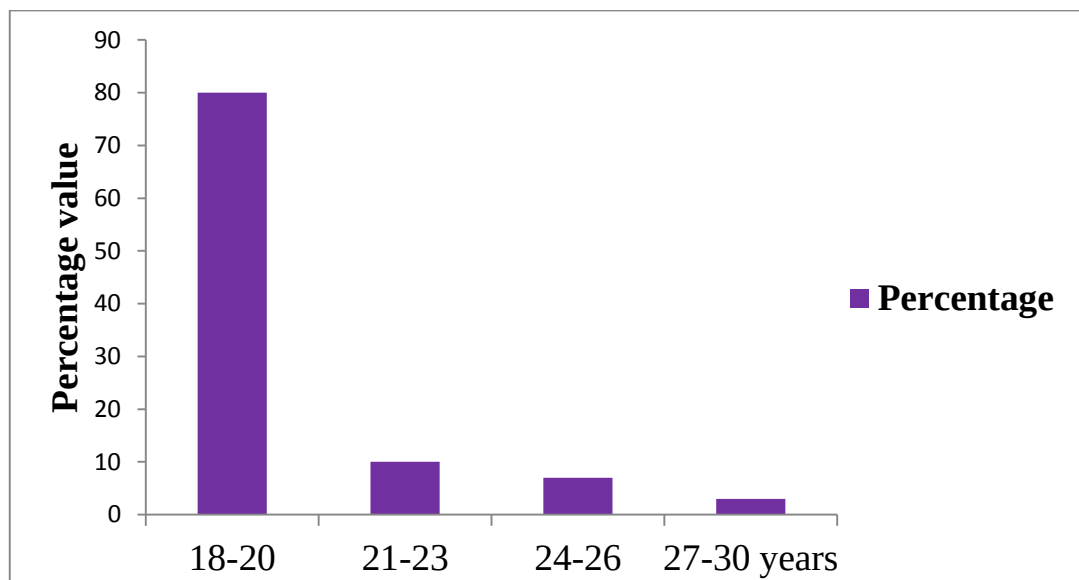


Figure 7: Shows percentage of age group among medical chekup by the fisrt candidate.

Age	Percentage
18-20	70%
21-23	15%
24-26	10%
27-30	5%

The results from the 2nd candidate.

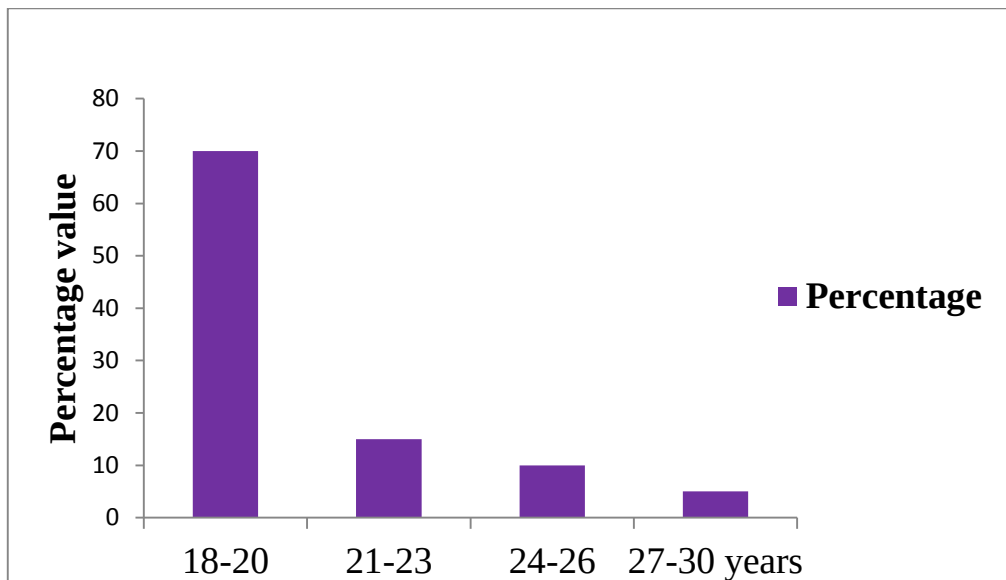


Figure 8: Shows percentage of age group among medical chekup by the second candidate.

Age	Percentage
18-20	60%
21-23	20%
24-26	18%
27-30	2%

The results from the 3rd candidate.

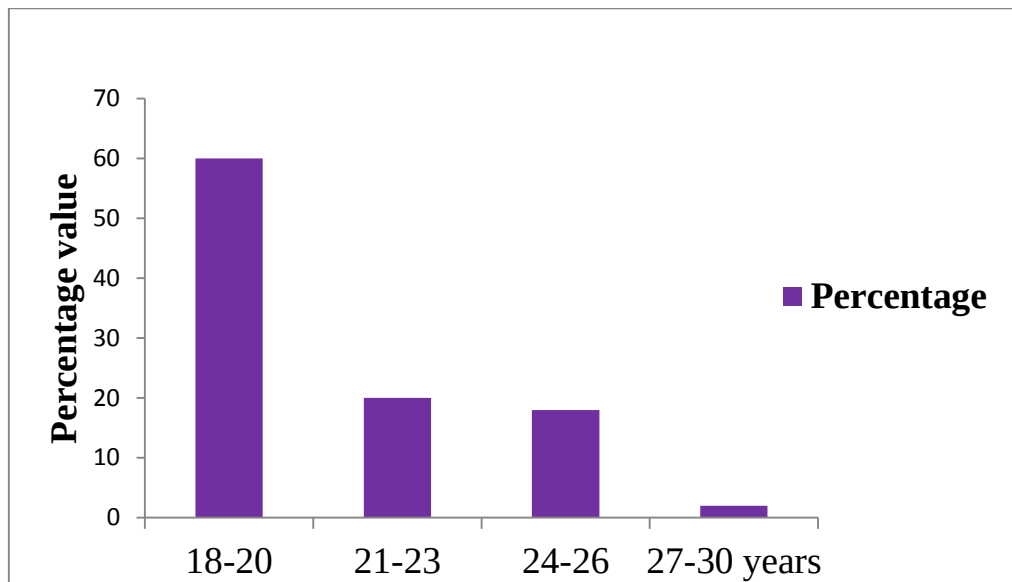


Figure 9: Shows percentage of age group among medical checkup by the third candidate.

Age	Percentage
18-20	70%
21-23	10%
24-26	10%
27-30	10%

The results from the 4th candidate.

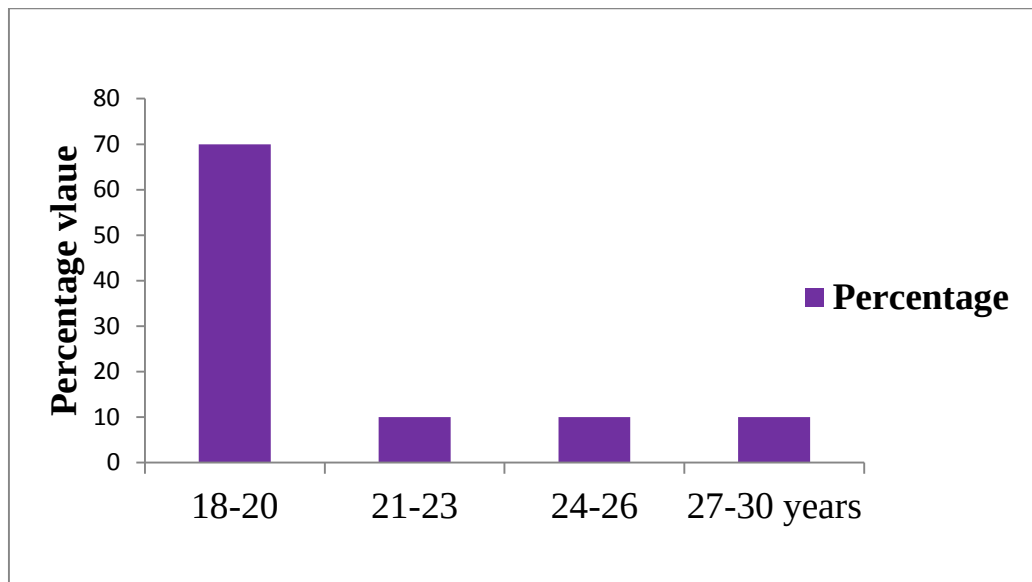


Figure 10: Shows percentage of age group among medical chekup by the fourth candidate.

Age	Percentage
18-20	80%
21-23	10%
24-26	5%
27-30	5%

The results from the 5th candidate.

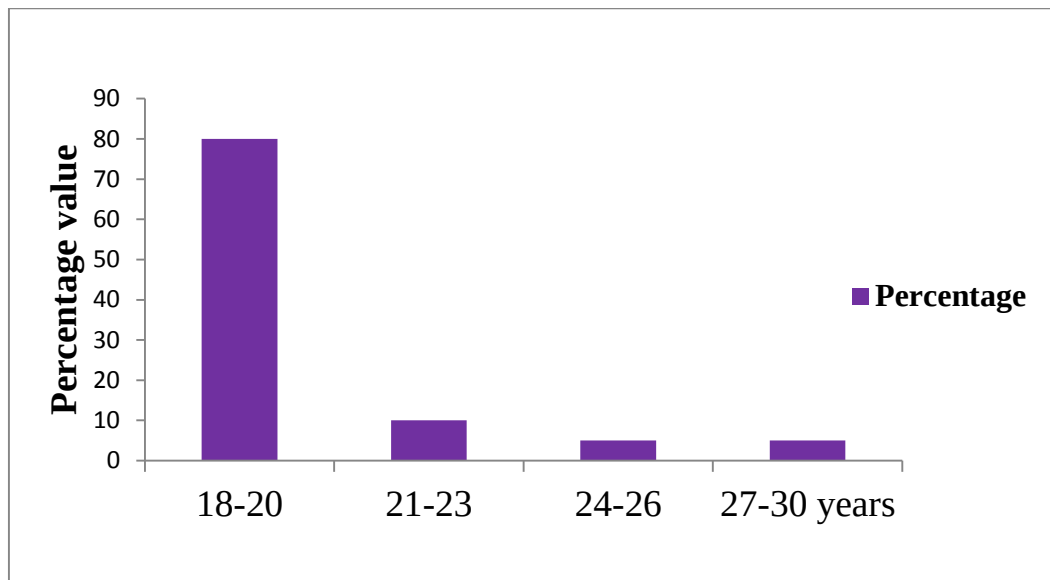


Figure 11: Shows percentage of age group among medical chekup by the fifth candidate.

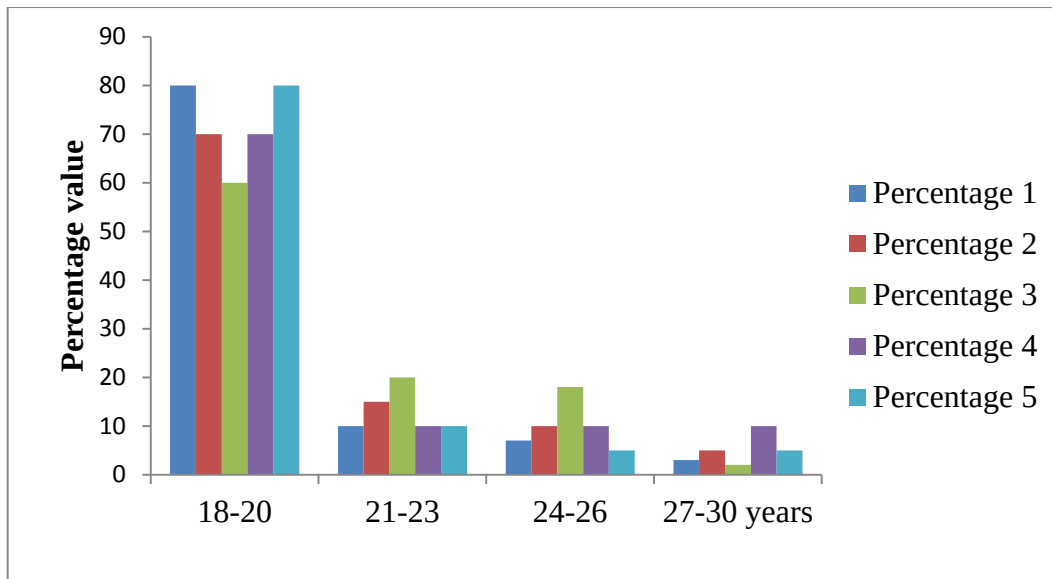


Figure 12: Shows aggregate chart for the percentage values of 1-5 under different age groups.

Pre-employment chest radiographs have been a point of debate and researchers have come up with results for as well as against it. There is an equation showing the Radiation dose ratio by chest X-rays. At first we calculate Collective dose from P.E.C then calculate Collective dose from natural background finally we calculate Radiation dose ratio by chest X-rays from dividing Collective dose from P.E.C by Collective dose from natural background.

1. Collective dose from P.E.C_(msv) = Chest X-Ray dose_(msv) × Number_(million).
2. Collective dose from natural background_(msv) = 3_(msv/year) × Number.

3. Radiation dose ratio= Collective dose from
P.E.C_(msv)/ Collective dose from natural
background_(msv).

By substitute:-

1. Collective dose from P.E.C_(msv)= 0.06×12.8
= $0.768_{(msv)}$.
2. Collective dose from natural
background_(msv)= $3 \times 12.8 = 38.4_{(msv)}$.
3. Radiation dose ratio= $0.06 \times 12.8 / 3 \times 12.8 = 0.02$

With consideration:-

- $3_{(msv)}$ is a globally number for natural background radiation.
- $0.06_{(msv)}$ is the chest X-Ray dose for adults.

A study done in Taiwan Industrial Park with a large sample of 17105 participants found that 22 participants showed positive findings suggestive of pulmonary tuberculosis.[13]

In a study done in Africa covering 7 private institutions as a part of the routine check-up for new job applicants over a period of 5 years, 168 out of 2540 (7%) showed abnormalities.[1]

These authors were in favor of routine pre-employment screening radiographs. In a few other studies, as mentioned below, the results were against

it. Tigges et al. reported that, out of 1282 radiographs that were done for routine or screening purposes, 15 chest radiographs showed major abnormalities. Fourteen of the 15 findings of major abnormalities (lung nodules, mass, atelectasis, and mediastinal lymphadenopathy) proved to be false-positives. No disease requiring treatment was diagnosed as a result of radiographic findings. The total cost for follow-up radiography and computed tomography was also very high.[14] Jachuck et al. reviewed 1000 prospective chest radiographs performed as pre-employment screening for NHS recruits and detected abnormalities in 8, out of which only 1 affected the employment of the individual. They also noted that the cost involved was very high for such a small detection rate and recommended against it.[15]

Ladd et al. also found the detection rate in routine pre-employment chest radiographs was too low where 5 out of 1760 cases were “relevant” and none of these affected employment. They concluded that this practice is expensive and could also be in violation of European law.[16] Lohiya et al.[7] and Abuchi et al.[10] also agree with the conclusion that use of routine chest radiographs is futile. Anne Cockcroft found that, out of 640 applicants, more than one-third underwent routine pre-employment chest radiographs specifically for tuberculosis for employment in the NHS and no cases of tuberculosis were detected, and hence, recommended against it.[2]

Ashenburg et al. conducted a retrospective analysis of 3266 pre-employment chest radiographs during recruitment for Eastman Kodak Company and found that only 25 (0.7%) had relevant findings and only 2 were

rejected based on the radiographs findings; they suggested that a radiograph should be done only if required basing on the clinical findings and past history.[17]

Two large studies, one done in Pakistan by Saima Naz et al. with a sample size of 63648, only 1368 (2.15%) showed significant abnormality leading to the candidates being declared unfit, [3] and in the other carried out in Malaysia by Izamin Idris et al., which included chest radiographs of more than 63% of 8315 individuals, showed the percentage of abnormality to be only 0.25%.[18]

Both these studies concluded that conducting routine chest radiographs is not recommended. The American College of Radiology proposed that the appropriateness of chest radiography goes up only in cases where there is a strong clinical indication or suspicion of cardiopulmonary disease and concluded that routine chest radiographs are inappropriate in the absence of any clinical concern.[18]

Akinola et al. also reiterated this fact concluding that, only in cases with suspected chest abnormalities, the percentage of abnormality was high, and hence suggested that the use of routine pre-employment chest radiographs should be reserved to cases where it is clinically indicated.[19]

In our tertiary level hospital, current practice is similar to that being followed in many parts of the country where new job applicants undergo a chest radiograph as part of the pre-employment medical checkup. In our study, the percentage of abnormality detected was 4.9%, and the percentage that needed further medical intervention (significant abnormality) was only 0.17%. The total

number of participants (4113) is larger than many studies that have concluded in favor of rejecting routine pre-employment screening.[1,13]

As our participants included applicants for vacancies in all cadres ranging from housekeeping, technical, nursing, and highly specialized doctors, we can assume that the data represents a fairly wide spectrum of the society. A limitation of our study is that, as the radiographs were reported by different radiologists, there is a possibility that minor abnormalities may not have been mentioned by all, if they were considered clinically insignificant.

Although the amount of radiation that one is exposed to during a chest radiograph is fairly low (0.02 mSv), considering such a low yield rate, this is unnecessary radiation for the large majority of individuals.

Considering the large numbers being done currently throughout the country, it would add significantly to the community radiation. The cost involved and time required for the test and its interpretation were not calculated in this study, but it would be significantly high when considered on a national scale.

We believe that a chest radiograph has no place in routine pre-employment medical screening. We recommend that a chest radiograph as a screening tool be restricted to those with history or clinical findings suggestive of thoracic disease.

CONCLUSION

According to the General Authority for Statistics in Saudi Arabia there are 9766784 non-Saudi workers for the second quarter of 2019 and 3090,248 Saudi workers and thus the total employees for the second quarter of 2019 is 12857032 and the Radiation dose ratio by chest X-rays for one quarter is 0.02 and this is a huge ratio for one quarter, accordingly the percentage of significant abnormalities detected which needed further medical intervention was small (0.17%). Although the individual radiation exposure is very small, the large numbers done nation-wide would significantly add to the community radiation, with added significant cost and time implications. We believe that pre-employment chest radiographs should be restricted to candidates in whom there is relevant history and/or clinical findings suggestive of cardiopulmonary disease. Routine pre-employment chest X-Ray shouldn't be done for candidates below 30 years old. Pre-employment medical checkup is so important, However pre-employment chest X-Ray is not been a routine test at least for employees before 30 years old. Implementing this recommendation will have a great cost reduction in our study 98% and in other studies from 71%.

ACKNOWLEDGEMENT

The author and the co-authors acknowledge the medical records staff and the PACS engineer for their help in acquiring patient demographic details.

REFERENCES

1. Kouamé N, Ngoan-Domoua AM, Konan AN. Systematic chest radiography during pre-employment check-up. *African Journal of Respiratory Medicine*. 2012;7:15-8.
2. Cockcroft A. Pre-employment chest radiography and NHS staff. *BMJ*. 1993;306:1286.
3. Naz S, Aziz T, Umair MM, Uzair MM. Chest X-ray: An unfair screening tool. *J Ayub Med Coll Abbottabad*. 2014; 26:554-8.
4. American College of Occupational and Environmental Medicine. Scope of Occupational and Environmental Health Programs and Practices. Consensus Opinion Statement. www.acoem.org/guidelines/article.asp?ID=35, Accessed 05/26/06.
5. Occupational Safety and Health Act. Code of Federal Regulations Title 29.1910.
6. Anonymous. Prevention. In: *Occupational Medicine Practice Guidelines*. Ed. Glass L. 2nd ed. American College of Occupational and Environmental Medicine. Beverly Farms, MA: OEM Press; 2004; 1-20.
7. Lohiya GS, Tan-Figueroa L, Lohiya P, Bui D. The futility of universal pre-employment chest radiographs. *J Nat Med Assoc*. 2006; 98:2019-23.
8. Samuel, V. J., Gibikote, S., & Kirupakaran, H. The routine pre-employment screening chest radiograph: Should it be routine?. *The Indian journal of radiology & imaging*, 2016; 26(3), 402.

9. Chukwuani, A. E., Osanaiye, A., & Franklin, O. An Audit of Routine Chest X-ray Done During Pre-employment Medical Screening in South-Western Nigeria. *Central African Journal of Public Health*. 2017; 3(4): 51-54.
10. Abuchi CS, Okpala OC. The relevance of pre-employment chest X-ray examination in Anabra State, Southeast Nigeria. *J Biomed Investig*. 2007;5:170-21.
11. Aldhebaib, A., Singh, O. G., Almutlaq, Z., Haq, F., Alharbi, A. A., Alotaibi, F. S., & Alharbi, K. O. Assessment of Clinical Outcomes of Outpatients Following Chest X-ray Imaging Performed at King Abdul–Aziz Medical City, Riyadh, Saudi Arabia. *Journal of Advances in Medicine and Medical Research*, 2018; 1-9.
12. Pachman, J. Evidence base for pre-employment medical screening. *Bulletin of the World Health Organization*, 2009; 87, 529-534.
13. Su SB, Chiu CF, Chang CT, Chen KT, Lin CY, Guo HR. Screening for pulmonary tuberculosis using chest radiography in new employees in an industrial park in Taiwan. *Am J Infect Control*. 2007;35:254-9.
14. Tigges S, Roberts DL, Vydareny KH, Schulman DA. Routine chest radiography in a primary care setting. *Radiology*. 2004; 233:575-8.
15. Jachuck SJ, Bound CL, Jones CE, Bryson M. Is a pre-employment chest radiograph necessary for NHS employees? *BMJ*. 1988; 296:1187-8.
16. Ladd SC, Krause U, Ladd ME. Are chest radiographs justified in pre-employment examinations? Presentation of legal position and medical evidence based on 1760 cases. *Radiologe*. 2006; 46:567-73.
17. Ashenburg NJ. Routine chest X-ray examinations in occupational medicine. *J Occup Med*. 1982; 24:18-20.

18. Izamin I, Rizal AM. Chest X-ray as an essential part of routine medical examination: Is it necessary? Med J Malaysia. 2012; 67:606-9.
19. Akinola RA, Akhigbe AO, Mohammed AS, Jaiyesimi MA, Osinaike OO, Jinadu FO, et al. Evaluation of routine chest X-rays performed in a tertiary institution in Nigeria. Int J Cardiovasc Res. 2014; 3:4.