# Prevalence of Thyroid Disorders Amongst Nuclear Medicine Scientists

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## ABSTRACT

There is a lack of research on Nuclear Medicine Scientists working in a field with constant low dose radiation exposure. This study was conducted to gather information regarding the prevalence of thyroid disorders amongst Nuclear Medicine Scientists in Australia. A web-based survey was completed by 131 Nuclear Medicine Scientists from throughout Australia. The data acquired was related to the prevalence of thyroid disorders amongst the normal population. The results indicated 20.6% (n=27) had been diagnosed with a Thyroid Disorder. It is estimated that thyroid disorders affect between 4-5% of all Australians [11]. The prevalence of thyroid disorders appears greater amongst Nuclear Medicine Scientists than the general population, but for many reasons this data may not be a true representation of the incidence of thyroid disorders in this population. This study hopes to initiate interest amongst researchers to further investigate the effects of constant low dose radiation exposure to Nuclear Medicine Scientists.

## Introduction

Radiation has had a stigma attached to it since the atomic bombs were dropped on Hiroshima and Nagasaki in 1945. The high radiation doses received by those in this tragedy had horrific effects, but little is known about the effect of constant low dose radiation exposure. Numerous studies have been conducted on thyroid cancer and thyroid disorders with the atomic bomb survivors, Chernobyl locals and x-ray workers but very few have been performed regarding those in the field of Nuclear Medicine, in fact none in Australia. Nuclear Medicine Scientists receive the highest radiation doses when compared to radiographers and radiation therapists [1]. The thyroid is one of the most radio-sensitive organs in the body [2] and is not routinely protected with shielding by Nuclear Medicine Scientists. Due to the lack of research conducted on the effect of radiation on Nuclear Medicine Scientists, we have obtained our background information on studies carried out on Medical Radiation Science workers (especially radiographers) from the rest of the world. In a study performed in Italy it was found that there was an increase in thyroid disorders amongst X-ray workers and they concluded that low-dose radiation exposure "may be a risk factor, for thyroid nodules" [3]. It was found by studies in Italy [4], China [5] and Britain [6] that there was a higher prevalence of neoplasms in radiographers.

Some studies had contradictory findings amongst the various Medical Radiation professions. One study found that radiation exposure received in diagnostic radiography in adulthood was relatively insignificant compared to the atomic bomb radiation (high-energy radiation) [7]. In the same study it was found that the incidence of thyroid cancer was minimal when receiving low-dose radiation in adulthood but was highly significant in low dose exposures occurring in childhood.

In a Swedish study it was found that women were at a greater risk of thyroid cancer due to a combination of increasing sex hormones and low-radiation exposure [8]. This was supported by a study which included a variety of essential factors that should be taken into consideration [9]. These included age during irradiation, age of first pregnancy, obesity and the years of constant low-dose radiation exposure [9]. This highlights some of the factors that need to be considered during analysis of data collected.

Due to the great diversity in the studies conducted involving the various countries, medical radiation professions and types of radiation received, it was concluded that there were many complications and diversions that could arise if we included all radiation workers. We have therefore decided to lead a research study to investigate the effects of constant low-dose radiation on one of the most radiosensitive organs, the thyroid, amongst the profession that receives one of the highest doses of radiation, Nuclear Medicine Scientists.

This article aims to investigate possible effects of low dose radiation on Nuclear Medicine Scientists. The method chosen to do this was by exploring whether or not there is a greater prevalence of thyroid disorders amongst Nuclear Medicine Scientists than is prevalent in the normal population. It was hypothesized that since the thyroid is a highly radiosensitive organ, any effects of low dose radiation may be seen in this organ before effects may be seen in other organs.

**Methodology**

An online web based survey was developed using Microsoft FrontPage. The survey was completed by 131 Nuclear Medicine Scientists throughout Australia. There were 12 questions in the online survey, consisting of both open-ended short answer questions and multiple-choice questions. The survey questions were focused on the respondent's age, gender, the total number of years he or she had been working in the field of Nuclear Medicine, whether or not they had been previously diagnosed with a thyroid condition, and whether or not they ever suspected that they may have had symptoms of a thyroid condition. An online survey was chosen as opposed to a written survey for cost effectiveness and its overall ease of access for the respondents and surveyors.

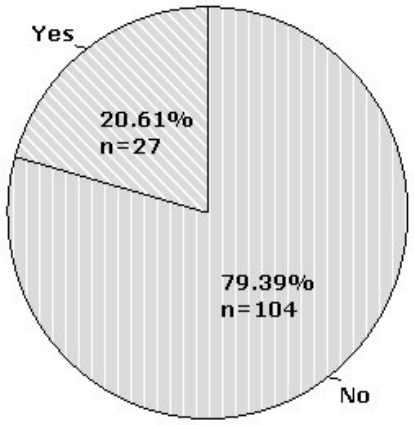
A list of the contact details of Nuclear Medicine departments and centers were obtained through the use of Yellow Pages online, the Australian and New Zealand Society of Nuclear Medicine (ANZSNM), and The University of Sydney School of Medical Radiation Sciences, Nuclear Medicine Clinical Education website. The contact details of 218 Nuclear Medicine departments across Australia were obtained. These departments were each mailed a letter of introduction outlining the aims and objectives of the project, and a flyer to encourage all Nuclear Medicine Scientist to take part in the survey. The Chief Nuclear Medicine Scientist at each center was asked to post the flyer onto a notice board to remind all fellow Scientists to take part in the online survey before its closing date.

The flyer was developed to encourage as many Nuclear Medicine Scientists to take part in the online survey as possible. An online consent page was also developed. This was to ensure that all participants were made aware of the University of Sydney's recognition of the survey as valid and ethically approved. Each participant was to declare that they agreed with the project terms before they were able to proceed to the survey page of the website. Of the 218 letters sent to Nuclear Medicine departments, 11 were returned as the centers had either combined with another center or were no longer operating. We received a total of 131 responses to our online survey.

**Results**

Analysed results indicated the prevalence of thyroid disorders amongst Nuclear Medicine Scientists to be 20.6% (n=27) (Fig.1). It is estimated that the sample size represents approximately 20% of all accredited Nuclear Medicine Scientists in Australia [10]. In comparison to the general Australian population, it is estimated that thyroid disorders affect 4 – 5% of all Australians [11]. It is also stated that around one in twenty Australians will experience some form of thyroid dysfunction in their lifetime [12].

Figure 1. - Diagnosed vs. Undiagnosed




The types of thyroid disorders diagnosed were 2.3% (n=3) with a Goitre, 0.7% (n=1) with Hashimotos**,** 3.1% (n=4) with Hyperthyroidism, 6.1% (n=8) with Hypothyroidism, 3.1% (n=4) with other types of Thyroid Disorders, 0.7% (n=1) with Thyroid cancer, 3.1% (n=4) with Thyroid nodules and 1.5% (n=2) with Thyroiditis (Table 1.0).

From Table 1.0 hypothyroidism is shown to be the most common amongst these disorders.

**Table 1.0 - Types of Thyroid Disorders Diagnosed**

| Type | Female | Male | Total |
|---|---|---|---|
| **Goitre** | 3 | 0 | 3 (2.3%) |
| **Hashimotos** | 1 | 0 | 1 (0.7%) |
| **Hyperthyroidism** | 4 | 0 | 4 (3.1%) |
| **Hypothyroidism** | 8 | 0 | 8 (6.1%) |
| **Other** | 3 | 1 | 4 (3.1%) |
| **Thyroid cancer** | 1 | 0 | 1 (0.7%) |
| **Thyroid nodules** | 4 | 0 | 4 (3.1%) |
| **Thyroiditis** | 2 | 0 | 2 (1.5%) |
| ***Total*** | *26* | *1* | *27* |
| ***Percentage*** | *19.8%* | *0.8%* | *20.6%* |

Table 1.1 shows the prevalence of hypothyroidism by age and gender. Fifty percent of hypothyroidism cases (n = 4) are from 41years and above.

**Table 1.1 - Prevalence of Hypothyroidism**

| | Hypothyroidism | |
|---|---|---|
| **Age Group** | **Female** | **Male** |
| **21 – 25** | 1 | 0 |
| **26 – 30** | 0 | 0 |
| **31 – 35** | 2 | 0 |
| **36 – 40** | 1 | 0 |
| **41 – 45** | 1 | 0 |
| **46 – 50** | 2 | 0 |
| **51 – 55** | 1 | 0 |
| **56 – 60** | 0 | 0 |
| ***Total*** | *8* | *0* |

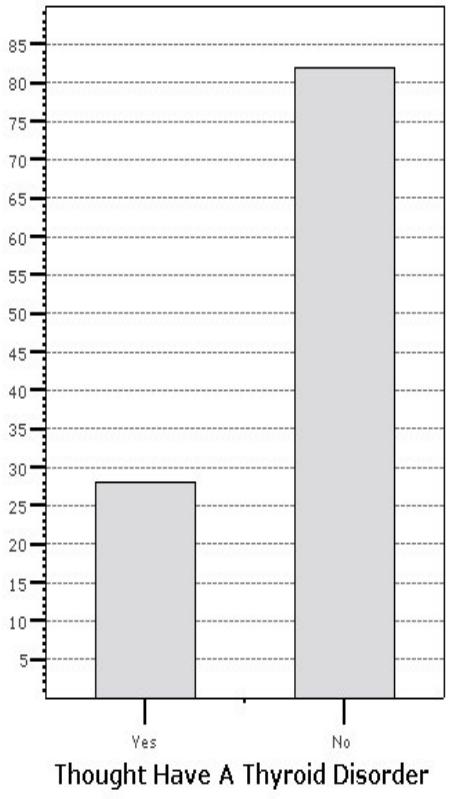
Table 2.0 shows prevalence of all the thyroid disorders compared to gender and age. The data shows that females have the highest prevalence of thyroid disorders (n=26) compared to males (n=1).

**Table 2.0 - Diagnosis by Age Group and Gender**

| | Diagnosed | |
|---|---|---|
| **Age Group** | **Female** | **Male** |
| **21 – 25** | 2 | 0 |
| **26 – 30** | 2 | 0 |
| **31 – 35** | 8 | 1 |
| **36 - 40** | 2 | 0 |
| **41 – 45** | 5 | 0 |
| **46 – 50** | 6 | 0 |
| **51 – 55** | 1 | 0 |
| **56 – 60** | 0 | 0 |
| ***Total*** | *26 (19.8%)* | *1 (0.8%)* |

Data obtained indicates 18.3% (n=24) of participants thought they may have had a thyroid disorder (Fig. 2). Between 15 – 24% of the Australian population is thought to have a thyroid disorder which remains undiagnosed [2].

Figure 2.




There were a number of reasons as to why the participants thought they had a thyroid disorder. The most commonly stated reasons were overweight, enlarged throat and feelings of lethargy.

The range of respondent ages was 21 to 57 with the average age being 34 (Table 3.0). From the table it can be seen that the most frequent age of respondents was 28.

**Table 3.0 - Age Distribution**

| | **Min.** | **Mode** | **Max.** | **Mean** |
|---|---|---|---|---|
| **Age** | 21 | 28 | 57 | 33.79 |

**Table 4.0 – Age Group Frequency and Percentage Diagnosed**

| **Age Group** | **Frequency** | **Diagnosed** |
|---|---|---|
| **21 – 25** | 24 | 2 (8.3%) |
| **26 – 30** | 36 | 2 (5.6%) |
| **31 – 35** | 28 | 9 (32.1%) |
| **36 – 40** | 9 | 2 (22.2%) |
| **41 – 45** | 13 | 5 (38.5%) |
| **46 – 50** | 14 | 6 (42.9%) |
| **51 – 55** | 5 | 1 (20%) |
| **56 – 60** | 2 | 0 (0%) |
| ***Total*** | *131* | *27 (20.6%)* |

The third column in Table 4.0 shows the number diagnosed with a thyroid disorder along with the percentage of the age group it represents beside this figure. From this data it can be seen that the highest percentage diagnosed was in the age group 46-50 with 42.9% of respondents diagnosed with a thyroid disorder.

**Discussion**

There could have been more responses if it were not for some limitations of the study. Difficulty was found in determining accurate and current addresses, hence 11 letters mailed out were returned. It is possible that numerous Nuclear Medicine Scientists were unable to be contacted due to being on holiday, maternity leave or career change. Lack of access to the internet at many of the centres may have also resulted in a decreased number of responses. Our survey was also boycotted by some who wished to not participate because they considered the survey to be "alarmist". This group considered the research topic to be of a very sensitive nature that could create unnecessary fear and anxiety amongst practicing Nuclear Medicine Scientists. In general the survey was participated in willingly and with much interest, although there were complaints regarding the ambiguity of one of the questions.

It is estimated that 4 – 5% of the general Australian population are affected by thyroid disorders [11]. Our results indicated that the prevalence of thyroid disorders amongst Nuclear Medicine Scientists to be 20.6% (n=27) (Fig.1). This indicates that the percentage of thyroid disorders to be greater amongst Nuclear Medicine Scientists compared to the normal population (Fig. 1). However, for many reasons this data cannot be taken as a true representation of the prevalence of thyroid disorders amongst the Nuclear Medicine population. There are factors that need to be considered in order to make a reasonable comparison between the two samples. These factors include: sample size, education, sex, age, years of constant low dose radiation exposure and even family history of the participants [4].

There was a discrepancy faced in this research in that our sample size varied greatly from the normal population. The Nuclear Medicine sample size was only 131; it could therefore be criticized for making a comparison between the two samples. An epidemiologist could have been employed to aid in making a more accurate correlation between the two samples.

It was shown in the results that Hypothyroidism was the most common thyroid disorder prevalent amongst Nuclear Medicine Scientists, all of whom happened to be females (Table 1.0). This is consistent with Hypothyroidism being the most common thyroid disorder and Hypothyroidism being more common in women than in men, affecting 6 to 10% of women over the age of 65 years [13]. From the results it was evident that 50% (n = 4) of the Hypothyroid cases are from ages 41 and above, which correlates to Hypothyroidism usually occurring after the age of 40 years [13].

The results in Table 2.0 show a much higher prevalence amongst females Nuclear Medicine Scientists than males; this is consistent with other data. It has been publicized in other studies that females are more susceptible to developing thyroid disorders [12]. Consequently, the increased number in thyroid disorders in our total results may have been attributed to the fact that the majority (more than half) of our respondents were females (Table 2.0).

It is important to consider that there are probably a lot more people from the general population who have thyroid disorders but have not been diagnosed with it. Between 15 – 24% of the Australian population is thought to have a thyroid disorder which remains undiagnosed [2],

therefore resulting in erroneous general population numbers for an ideal comparison. On the other hand, Nuclear Medicine Scientists who are better medically educated are more likely to query the symptoms of thyroid disorders and therefore seek a professional diagnosis by a physician. As indicated in figure 2, 18.3% of participants thought they may have had a thyroid disorder. Nuclear Medicine Scientists who were diagnosed or had queried symptoms of thyroid disorders would have been more interested in the research and therefore more likely to respond to the survey. This may have skewed the high number of positive responses to the presence of thyroid disorders or symptoms.

In a health survey of radiological technologists, it was found that there was a clear trend linking radiation exposure to the number of years that people had worked as radiological technologists. This survey of more than 143, 000 radiological technologists in America reported that people who had worked for more than 40 years were 3 to 7 times more likely to develop a thyroid disorder of some sort [4]. Some data was acquired about how long the participants had been working in the field as a crude measurement of radiation exposure. This data was not easily analysed and found to be a poor measurement of radiation exposure.

In another research source, it was reported that the latent period between exposure and the appearance of a cancer varied depending on the type of cancer induced. Solid tumours, for example thyroid cancers, show latent periods of approximately 20-50 years [14]. The percentage diagnosed is greatest in the age groups 41-45 and 46-50 (Table 4.0). This is consistent with hypothyroidism being the most common thyroid disorder and usually striking after 40 years of age [13]. It was difficult to differentiate between the causes of thyroid disorders as being radiation exposure or a normal prevalence within the age group.

A higher incidence of thyroid conditions has been linked to those with family history of the diseases [12]. No information was acquired regarding the participants' family history. As a result it was not possible to establish if thyroid disorders could be attributed to a genetic link or to radiation exposure. Finally there was great difficulty in trying to correlate the data collected with the general population due to the limited resources available.

## Conclusion

This study was conducted to gather information regarding the prevalence of thyroid disorders amongst Nuclear Medicine Scientists in Australia. Data acquired was related to the prevalence of thyroid disorders amongst the general population. Our results showed an increase in thyroid disorders amongst Nuclear Medicine Scientists compared to the general population. However, for many reasons this data may not be a true representation of the incidence of thyroid disorders amongst the Nuclear Medicine population. These results will hopefully initiate future investigation into the possible effects of low dose radiation exposure.

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