The Prevalence of Iodine Deficiency and its Correlation with Goiter Size in the Goitrous Population of Paracelis, Mountain Province*

Raymond U. Oribio, Arnel B. Paguel, Robert E. Tolentino, & Ferdinand P. Pinangat

Abstract

The study was conducted with the following objectives: to establish the prevalence of Iodine deficiency in the goitrous population of the municipality of Paracelis, Mt. Province; to determine correlation between urinary iodine concentration and goiter grade; and, to establish the epidemiologic data of age and sex in relation to Iodine deficiency and goiter. A total of 2,253 patients underwent preliminary screening for goiter using palpation and inspection maneuvers according to the World Health Organization guidelines for the grading of goiter. Patients found or suspected to have goiters were then further subjected to more thorough physical examination where the goiters were then graded on a scale of I to IV. Of these 259 (11.49%) had goiter of varying grades and occurring at a male: female ratio of 1:21. The goiter grade with the highest prevalence was Grade I (64%) while the least common was Grade III (5%). Goiter prevalence was highest in the age bracket of 31 to 40 years old. Iodine deficiency was present in 7.8% of the population studied or 68% of the goitrous population. Iodine deficiency occurred higher in females (66%), was most prevalent (27%) in the 31 to 40 age bracket and in goiter Grade I (64%).

This study shows that the prevalence of Iodine deficiency in the goitrous population of Paracelis, Mt. Province remains high at 68% and that Iodine deficiency remains to be a public health problem in the municipality. There is a correlation between Iodine deficiency and age gradually increasing from birth, peaking at age 31 to 40 years and gradually declining thereafter. There is no significant relationship between goiter grade and age, goiter grade and gender, iodine deficiency and gender, and iodine deficiency and goiter grade.

Keywords: *Iodine deficiency, goiter, Rapid Urinary Iodine Test*

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INTRODUCTION

Clinical practice of Medicine has exposed us to the reality that goiter does exist in a great percentage of the Cordillera people. It has also made us aware that government agencies are doing their best in dealing with the problem tagged as Iodine deficiency. Iodized salt and Iodine capsules are being distributed to the affected population without the benefit of determining urinary Iodine concentration for the main reason that Iodine deficiency is said to be the major etiology of goiters in the mountain region. However, it is not to be ignored that hyperthyroidism may also be goitrous. The use of large amounts of Iodine in hyperthyroid patients initially block thyroid hormone synthesis, but after two weeks of exposure, this same Iodine is then used up by the thyroid to manufacture more thyroid hormones rendering the patient more hyperthyroid.[1] In this case, the Iodine will do more harm than good. Thus, we need to know how much of the goitrous population is indeed iodine deficient.

The grading of goiter as proposed by the World Health Organization is used to determine the size of a goiter based on inspection and palpation findings.[2] There is a need to know if there is any correlation between goiter size and the degree of iodine lack among those found to be iodine deficient. This could guide government health workers in determining the target population for Iodine supplementation in the community.

Thyroid gland inspection and palpation are parts of routine physical examination which could detect the presence of any abnormality in the thyroid gland. These findings can then be used to classify the patients according to a grading system based on palpation and inspection findings and as prescribed by the World Health Organization (WHO).[2]

The incidence of Iodine deficiency in the mountain regions is perceived to be high. An incidence that has led the clinical practitioner and the layman as well to perceive every case of thyroid gland enlargement as equivalent to Iodine deficiency with subsequent administration of high doses of Iodine. This measure is indeed beneficial for those having iodine deficiency. However, it must be stressed that not all goiters are iodine deficiency related. There are other conditions such as

Grave's disease, thyroiditis, hyperthyroidism, simple goiter which present as goiters but which are not iodine-related. The administration of Iodine in these cases may, at the very least, be of no help and at the worst, would contribute further to thyrotoxicosis.[1] Chronic use of high doses of Iodine in endemic goiter may result in thyrotoxicosis and in hyperthyroid cases, the use results in an escape from the initial blocking effect of Iodine (Wolf-Chaikoff effect) eventually giving in to the escape from the Wolff-Chaikoff effect and to the Jodbasedow phenomenon where the administered iodine will then be used up to form more thyroid hormones thereby rendering the patient more thyrotoxic.[1] This was described by Madeiros –Neto in an observation where there was a noted increase in the incidence of thyrotoxicosis after institution of iodized salt in Europe and South America and introduction of Iodized bread in Holland and Tasmania.[3] Therefore, distribution of products such as salt, iodine capsules and the like should be qualified and limited only to those proven to be having iodine deficiency.

The Cordillera Region has been a known endemic area for Iodine deficiency disorders with a goiter prevalence as high as 93%.[4] To address this, the government has initiated programs such as iodinization of salt as well as educational campaigns aiming at educating the general public about the importance of iodine in the diet. With these programs in operation, did the incidence or prevalence of iodine-deficiency disorders change in this region? Are we still dealing with the same statistics as a decade ago?

The current prevalence of iodine deficiency in the goitrous population must therefore be established in this region to serve as a basis for the improvement of the implementation of government policies addressing the issue of Iodine deficiency. Furthermore, the study aims to determine correlation between the urinary iodine concentration and goiter grade and to establish the epidemiologic data of age and sex in relation to iodine deficiency and goiter.

MATERIALS AND METHODS

This is a descriptive study performed during a medical mission of the Medical Outreach Missions Foundation, Inc. (MOMFI) in Paracelis, Mountain Province on April 21 to 26, 2003.

Paracelis is the easternmost and largest municipality of the Mountain Province consisting of 11 barangays. Five of these barangays were visited by the mission group. Based on the census in the year 2000, the municipality has a population of 18,985 residents.[5]

During the medical mission, all patients underwent preliminary screening for goiter using palpation and inspection maneuvers by the concurrence of two examiners and were classified according to WHO guidelines for the grading of goiters. Those patients without goiters proceeded with their medical examinations. Patients found or suspected to have goiters were then further subjected to more thorough physical examination where the goiters were then graded based on the WHO recommendation which is as follows[2]:

Grade 0 = no goiter
Grade I = goiter determined by palpation
Grade II = goiter noted with the neck hyperextended
Grade III = goiter noted with the neck in normal anatomic position
Grade IV = goiter noted even from a distance

Goiters suspected to be Grade I were then measured for the length and width of each lobe in centimeters and those found to have dimensions more than the normal dimension of 4cm x 2cm x 2cm but did not satisfy the criteria for Grades II to IV were classified as Grade I. Patients who indeed had goiters were asked to submit at least 1 milliliter of urine specimen for Urinary Iodine determination.

Urine samples were tested for urinary iodide concentration using the Rapid Urinary Iodide Test (by Merck), a semi-quantitative determination, which relies on an iodide catalyzed oxidation reaction between tetramethylbenzidine and peracetic acid. The reaction causes the sample solution to change color to green, greenish-blue or blue when the urinary iodide reaches at least 10ug/ml (100ug/L).[6] The sample solution is them compared to a color scale that would classify urine reactions to less than 10ug/100ml (100ug/l), more than 10ug/ 100ml(100ug/L) up to 30ug/100ml (300ug/L) and more than 30ug/ 100ml(300ug/L). The results were then categorized according to the epidemiological criteria for assessing iodine nutrition based on urinary iodine concentrations as defined by the WHO, the UNICEF and the

International Council for Control of Iodine Deficiency Disorders (ICCIDD) which is as follows[7]:

Less than 10ug/100ml (100ug/L) - Iodine deficiency
10 to 29.9ug/100ml (100-300ug/L) - Optimal Iodine nutrition
More than 30ug/100ml (300ug/L) - Excessive Iodine nutrition

Iodine deficiency, in this study, is thus defined as a urine iodine concentration less than 10ug/dl or 100ug/L.

Patients were then classified according to age and sex in relation to goiter grade and urinary iodine levels. The relationships of these variables were then determined using the Chi Square test.

RESULTS

A total of 2,253 patients were seen during the mission (Fig I). Of this, 259 (11%) were noted to have goiters of varying grades and this was the population studied. Demographic characteristics revealed a female predominance at 95% and a male to female ratio of 1:21. Iodine deficiency was noted in 68% of the goitrous population. With regards to iodine deficiency and gender, the males showed a 42% prevalence rate while the females registered 70% prevalence. Iodine deficiency was noted to increase with age from birth and peaking at the age range of 31 to 40 years old and then gradually declining from thereon (Fig VII).

Grade I goiter was the most prevalent in both sexes followed by Grades II, IV and III, respectively (Fig VIII). In all age groups, the most prevalent goiter grade was grade I followed by grade II. The prevalence of all grades of goiter showed a progressive increase from birth and again peaked at 31 to 40 year age range and then declining thereafter (Fig IX).

The relationships of iodine deficiency and age, iodine deficiency and gender, goiter grade and age, goiter grade and gender and iodine deficiency and goiter grade were all tested using the Chi Square and revealed that only Iodine deficiency and age showed a significant relationship (p value =.022). All the other relationships showed non-significant correlations.

DISCUSSION

In 2003, WHO stated that Iodine deficiency is the world's most prevalent, yet easily preventable cause of brain damage.[8] It affects almost all continents and in the Southeast Asian and Eastern Mediterranean regions, 172 million people are affected by goiter and another 600 million are at risk of developing iodine deficiency disorders (IDD) [8]. In these regions, only Thailand and Bhutan have virtually eliminated the problem. The primary method employed was salt iodinization. From the WHO report of 2003, Bhutan showed the highest percentage of households using iodized salt at 95%, followed by Thailand at 79%, while the Philippines was at the lower end of the spectrum registering only 24%[4] utilization and ahead only of the Maldives at 8%.

Philippine statistics show a curious increase in goiter prevalence from 3.5% in 1987 to 6.7% in 1993.[4] Furthermore, the Food and Nutrition Research Institute (FNRI) national survey in the year 2000 showed a national median urinary iodine excretion rate of 71ug/L which places the Filipino population within the mild iodine deficiency category[4]. From the same report, it is said that Iodine Deficiency, encompassing mild, moderate and severe degrees, clearly outweigh normal iodine excretion in school aged children at a combined prevalence of 65% and 35%, respectively. Gatbonton in 2002 reported that endemic goiters were highest in the Mountain Province at 93% followed by Bukidnon at 71% and Oriental Mindoro at 56%. It is this compelling reason why the study group decided to join the medical mission in Paracelis, Mt. Province.

The Philippine government recognizes this public health problem and has in fact laws and programs geared towards the correction of the problem like the Republic Act 8172 of 1995, otherwise known as the "Asin Law" and the "Patak sa Asin Campaign" launched by the Department of Health in October 2002. In spite of these, although 87% of Filipinos are aware of the importance of Iodized salt, only 24% use it regularly.[4]

Goiter is one of the manifestations of thyroid disorders and may be a result of various causes like autoimmune as in Grave's disease; inflammatory like thyroiditis; Iodine deficiency as well as excess; thyroid malignancies and other endocrine disorders that may affect

thyroid function or anatomy as in acromegaly.[1] Iodine deficiency, as a cause of goiter, is the main concern of this study.

Iodine is the raw material which the thyroid gland processes through enzymatic reactions to produce the thyroid hormones triiodothyronine (T3) and thyroxine (T4).[1] This process is further regulated by higher centers, the hypothalamus and the pituitary gland which secrete Thyrotropin Releasing Hormone (TRH) and Thyroid Stimulating Hormone (TSH) which directly influence thyroid gland activity. The thyroid hormones, on the other hand, modulate these higher centers via positive or negative feedback depending on the ambient thyroid hormone status to produce an increase or a decrease in the activity of the control axis. In Iodine deficiency states, there is a relative or absolute decrease in the levels of the thyroid hormones as a result of the lack of the raw material. This exerts a positive feedback on the hypothalamus and pituitary with a resultant increase in the levels of TRH and TSH in the hope of increasing thyroid hormone levels.[1] TSH is one of the growth factors for the thyroid gland. So that, in iodine deficiency, the increase in TSH would result in the development of goiter.

Using epidemiologic criteria for IDD to be classified as a public health problem, there must be more than 5% goiter prevalence and at least 50% prevalence of urine iodine excretion less than 100ug/L in the whole population.[8] Our study showed a goiter prevalence of 11.49% and 68% prevalence of urinary iodine excretion below 100ug/L which therefore indicates that iodine deficiency is a public health problem of the locality studied that must be addressed.

Our study showed a progressive increase in the prevalence of iodine deficiency from birth and peaking at 31 to 40 years old and then gradually declining thereafter. This observation showed a p value of 0.022 which is significant and indicative of an association between age and iodine deficiency. This observation may be explained by the fact that the Recommended Daily Allowance (RDA) for Iodine increases with age and peaking at 150ug/day in adulthood. Such requirements are further increased in conditions of pregnancy and lactation to 200 and 250ug/day, respectively.[7] The increasing requirement of iodine in adulthood plus the significant events of pregnancy and lactation during the reproductive age, in the setting of a persistently deficient supply of iodine may explain the observed peaking of the prevalence of iodine

deficiency in middle age. The observed decline after middle age may be due to the generalized slowing of metabolism of aging which would require a relatively lower amount of iodine.

The study also showed a trend of increasing goiter prevalence with age with peak prevalence at 31 to 40 years old and then gradually declining thereafter. Vitti et al, in 1998 showed that the highest prevalence of goiter occurred between 36-55 years of age[9], a finding that seemed to be echoed by our findings. However, this observation yielded a p value of 0.135 which was a non-significant correlation between goiter grade and age. Vitti explained their findings of an increasing prevalence of goiter in older individuals to be the consequence of a more severe iodine deficiency in the past and a long-standing exposure to it compared to the younger age groups.

Correlating iodine deficiency and goiter, it is said that exposure to more severe iodine deficiency would lead to higher prevalence of goiter. Our study showed that iodine deficiency was indeed more prevalent (68%) in the goitrous population. This observation, however, was non-significant (p value= 0.270).

When gender is taken into account, females are more commonly affected by thyroid disorders. This gender difference is explained by the fact that estrogens appear to increase TSH response to TRH by increasing the number of TRH receptors in the pituitary thyrotropes which in turn lead to an increased thyroid gland activity and thus, iodine requirement.[1] However, our study failed to show any correlation between these two factors.

IDD not only results to goiter but may affect different ages in different forms ranging from abortion, stillbirths and cretinism in the fetus to goiter, hypothyroidism, endemic mental retardation and decreased fertility in the adult.[9] These disorders potentially affect the individual mental and physical capabilities. And when seen in the large portion of a community or a nation, the problems are magnified with repercussions on the community or national functioning and productivity.

CONCLUSIONS

Based on the findings of the study, we therefore conclude that the prevalence of Iodine Deficiency in the goitrous population of Paracelis, Mt. Province remains high at 68% and that Iodine deficiency remains to be a public health problem in the municipality studied. There is a correlation between Iodine deficiency and age gradually increasing from birth, peaking at age 31 to 40 years and gradually declining thereafter. There is no significant relationship between goiter grade and age, goiter grade and gender, iodine deficiency and gender and iodine deficiency and goiter grade.

RECOMMENDATIONS

The authors recommend the following:

1. That there should be an intensification of the Iodine Supplementation programs of the government and the education of the public on the use of Iodized salt especially in identified Iodine deficient areas of the country like the Cordillera region.

2. That Supplementation programs should target all age groups most especially the middle aged group.

3. That IDD must be viewed not just as another health issue but as a social issue and its control promoted a social obligation with the participation of various sectors including the community.

4. That there should be a strong commitment at the political level and from salt producers to correct this social issue.

5. That further studies must be carried out to establish the current prevalence of iodine deficiency in identified areas of iodine deficiency and to compare such with previous data in order to evaluate the implementation of supplementation programs currently in operation.

6. That further studies be carried out to determine the incidence of thyroid disorders associated with iodine deficiency like thyroid malignancy, autoimmunity and hyperthyroidism.

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THE AUTHORS

RAYMOND U. ORIBIO, MD, FPCP: Internist-Adult Endocrinologist; Chairman, Department of Pharmacology, SLU College of Medicine.

ARNEL B. PAGUEL, MD, DPPS: Pediatrician; Chairman, Department of Physiology, SLU College of Medicine.

ROBERT E. TOLENTINO, MD: Internist; Section Head, Department of Pharmacology, SLU College of Medicine; Director, SLU MOMFI.

FERDINAND P. PINANGAT, MD: Pediatric Resident-in-Training, Department of Pediatrics, SLU Hospital of the Sacred Heart.

APPENDICES

Table I. Patient Characteristics

Age(yrs.)	Sex		Total
	Male	Female	
0 to 10	0	1	1
11 to 20	2	24	26
21 to 30	4	49	53
31 to 40	1	70	71
41 to 50	0	53	53
51 to 60	1	22	23
61 to 70	3	17	20
71 to 80	1	11	12
More than 80	0	0	0
TOTAL	12	247	259

Table II. Distribution of the Grades of Goiter

Goiter Grade	Number
I	167
II	53
III	14
IV	25
Total	**259**

Table III. Goiter grade and Gender distribution *(p value = 0.567)*

Goiter Grade	Sex		Total
	Male	Female	
I	8	159	167
II	1	52	53
III	2	12	14
IV	1	24	25
Total	12	247	***259***

Table IV. Goiter grade and Age distribution (*p value=0.135*)

Goiter Grade	Age (yrs)									Total
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	
I	1	23	41	47	28	12	9	6	0	167
II	0	2	8	11	16	7	6	3	0	53
III	0	1	1	2	5	1	3	1	0	14
IV	0	0	3	11	4	3	2	2	0	25
Total	1	26	53	71	53	23	20	12	0	***259***

Table IV. Iodine deficiency and Gender distribution *(p value= 0.086)*

Urine Iodine Concentration (ug/100ml)	Sex		Total
	Male	Female	
<10	5	172	177
>10	7	75	82
Total	12	247	**259**

Table V. Iodine deficiency and Goiter grade distribution *(p value = 0.270)*

Goiter GradeUrine	Iodine Concentration (ug/100 ml)		Total
	<10	>10	
I	109	58	167
II	42	11	53
III	10	4	14
IV	16	9	25
Total	177	68	**259**

Table VI. Iodine deficiency and age distribution *(p value= 0.022)*

Urine iodine Concentration (ug/100ml)	Age								(yrs)
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Total
<10	1	13	32	49	36	18	18	10	177
10-30	0	13	21	22	17	5	2	2	82
Total	1	26	53	71	53	23	20	12	**259**

Figure I. Distribution of Goiter in the population examined

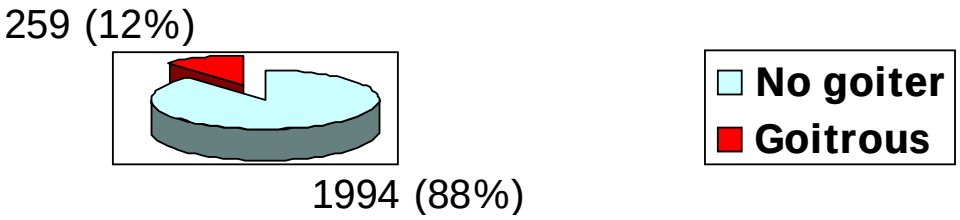

Figure II. Sex Distribution of the Goitrous Population

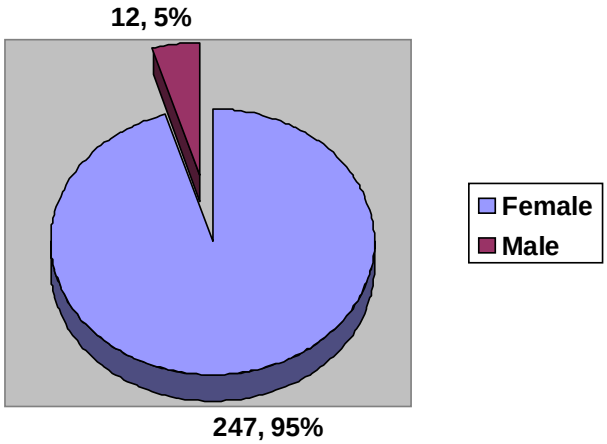

Figure III. Prevalence of Iodine Deficiency

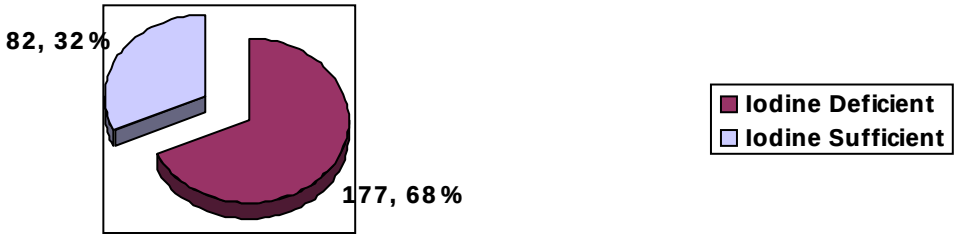

Figure IV. Urinary Iodine in Males

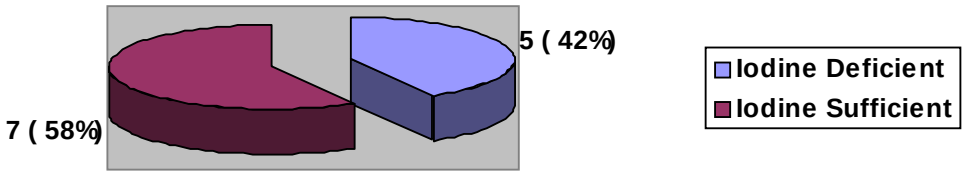

Figure V. Urinary Iodine in Females

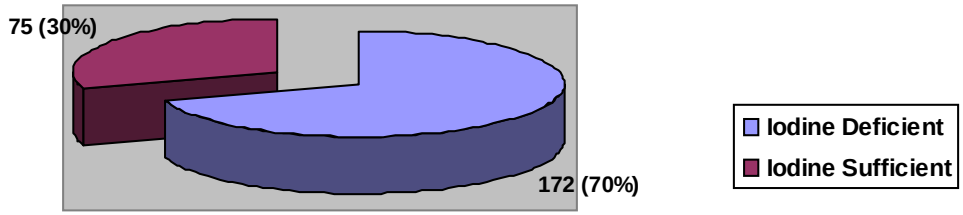

Figure VI. Distribution of Goiter Grades

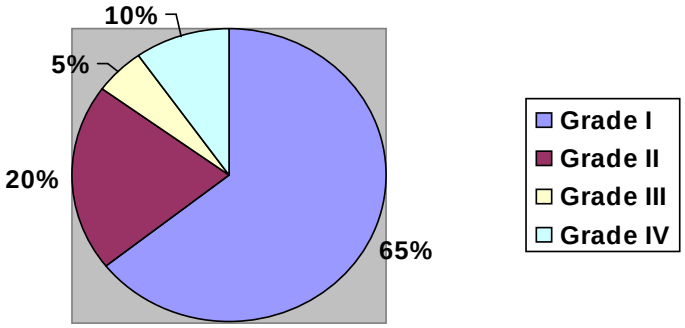

Figure VII. Distribution of Urinary iodine in the Different Age Groups

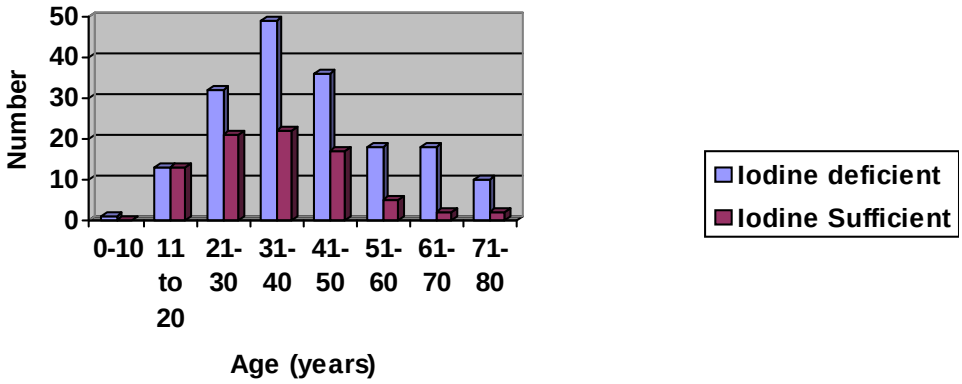

Figure VIII. Distribution of Goiter Grades in both Genders

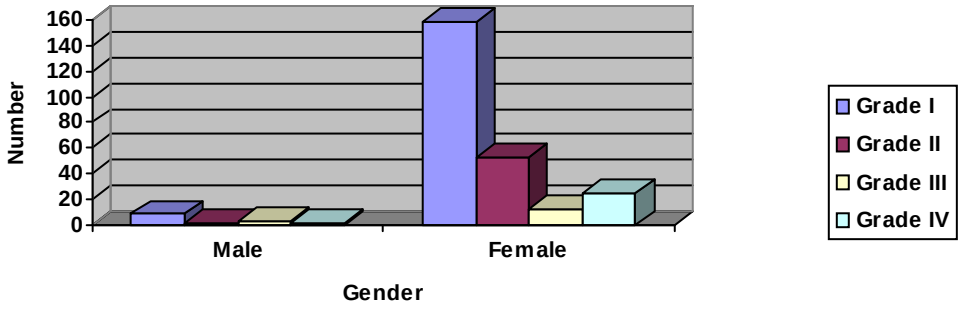

Figure IX. Distribution of Goiter grades in the different age groups.