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# Increasing of Iodine Intake Decrease the High Risk of Goitre in Smoking Men

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## Abstract

**Background:** An association between smoking and the risk of goitre is reported in some, but not all studies. We investigated the association between smoking, goitre and iodine intake, with respect to different risk factors in 483 healthy men in Germany.

**Methods:** A total of 483 healthy male employees of 4 institutions in Essen in Western part of Germany, aged between 17 and 68 years ( $43.1 \pm 9.6$  y) were examined by ultrasound of the neck to determine the thyroid volume between April 2001 and April 2002. Information on age, BMI, smoking, daily use of iodized salt, and familial history of thyroid disorders were assessed by standardized questionnaires. Logistic regression analysis was performed to adjust for smoking, age, iodine status and familial history of goitre.

**Results:** The overall prevalence of goitre was 25.7%. Median thyroid volume among smokers, ( $23.4 \pm 10.1$  ml), was higher ( $p < 0.001$ ) as compared with non-smokers ( $19.4 \pm 7.8$  ml). Goitre was present in 77 out of 204 smokers (37.7%) vs. 47/279 (16.8%) in non-smokers (odds ratio: 3.0;  $p < 0.001$ ).

Smoking ( $p < 0.001$ ) and increasing age ( $p < 0.001$ ) was associated with goitre prevalence, but not BMI and the family history of goitre. Iodine status alone failed just to reach the significance level but revealed a clear trend. And there was significant prevalence of goitre in smoking men who did not take iodine salt compared to smoking men with regular intake of iodine salt ( $p = 0.018$ ).

**Conclusions:** Smoking increase the risk of goitre in men that can be decreased by taking iodine.

**Keywords:** Thyroid; Goitre; Iodine; Smoking; Male

## Introduction

Goitre is a major health problem in Germany with an annual cost for treatment estimated at 1 billion Euro [1]. The etiology of simple endemic or sporadic goitre depends on genetic and environmental factors. The major factor, however, remain iodine deficiency [1,2].

Despite recent improvement of iodine supplementation in Germany since 1989 [3-8], the prevalence of goitre in Germany remains substantial [9,10].

An association between smoking and the risk of goitre have been reported in several studies predominantly or exclusively including females [11-17], but none in males.

In this prospective study, we investigated the prevalence of simple goitre among healthy smoker males in west part of Germany as compared to non-smokers with respect to age, iodine status and history of goitre in the first degree relatives.

## Methods

### Study design

A total of 483 healthy male employees of 4 institutions in Essen (Bethesda Essen and Karstadt) and Muelheim (Siemens and Mannesmann) in western part of Germany aged between 17 and 68 years (range:  $43.1 \pm 9.6$  y) were examined by ultrasound of the neck to determine the thyroid volume.

Ultrasound was performed by one experienced investigator (J.F.) with a Siemens Sonoline SI-400 using a 7.5 MHz linear scanner. The ultrasound was performed according to standardized criteria and the volume of thyroid was determined as the sum of  $\pi/6 \times \text{lengths} \times \text{width} \times \text{depth}$  of both lobes. Goitre was defined as a thyroid volume exceeding 25 ml.

All subjects with known thyroid disorder were excluded from this analysis. Information on date of birth, date of screening, sex, daily use of iodized salt, history of previous

diseases including benign diseases of thyroid, history of thyroid disorders in the first degree relatives, and type and amount of smoking were assessed by standardized questionnaires.

Smoking was defined as consuming more than 10 cigarettes daily for at least 5 years. Because of small number of cases in groups of cigar and pipe smokers, we excluded 2 cigar and 2 pipe smokers from the analyses.

## Statistics

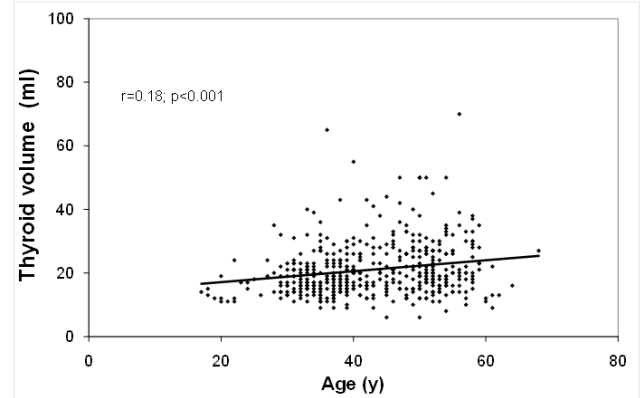
The general descriptive analysis was performed using Microsoft Excel (Version 7.0) and PASW-Statistics (version 19.0). Values for continuous variables are given as means  $\pm$ SD. Statistical differences between groups and comparison of frequencies between groups were calculated with the *Chi-Square* test or the Fisher's exact test for the  $2 \times 2$  contingency tables.

Linear regression analysis was performed for continuous variables and logistic regression analysis was performed for the binary dependent variable, presence of goitre, to adjust for age, smoking, iodine status and familial history of goitre. Parameters were estimated using a least square and maximum-likelihood methods and the significance level was assessed using t-Test or Wald test respectively. A p-value below 0.05 was considered to be statistically significant.

## Results

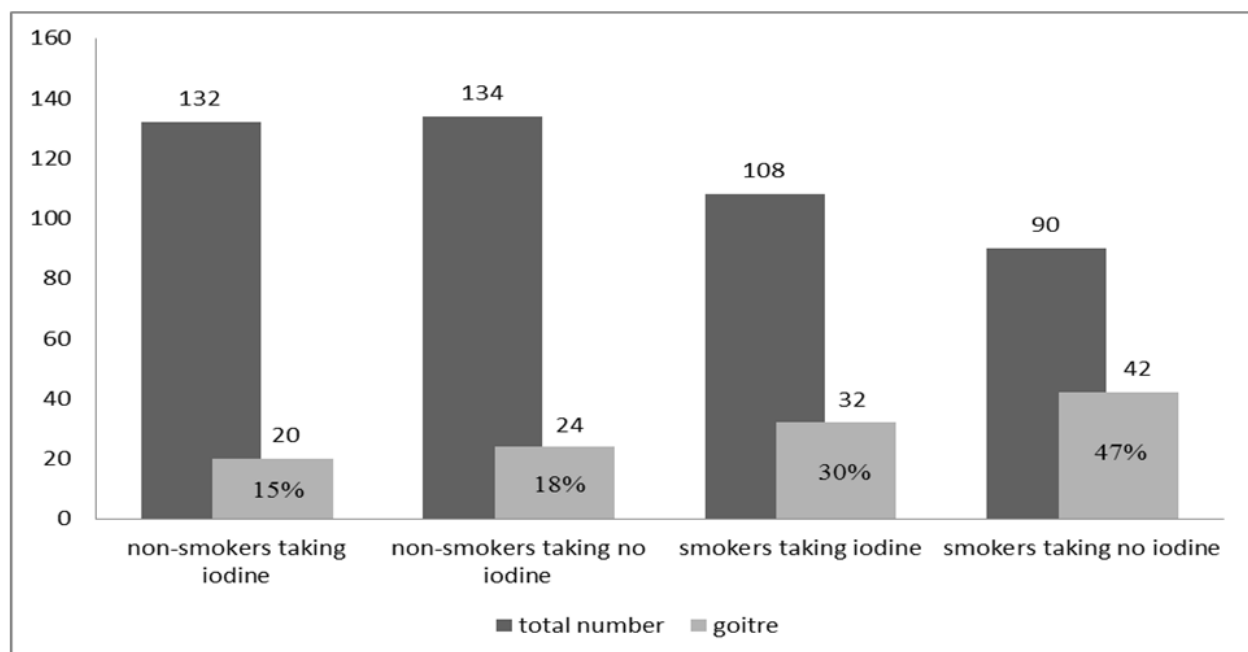
The overall thyroid volume correlated ( $r=0.18$ ;  $p<0.001$ ) with increasing age (**Figure 1**). The overall prevalence of goitre was

25.7% (124/483). Median thyroid volume among smokers ( $23.4 \pm 10.1$  ml), was higher ( $p<0.001$ ) as compared with non-smokers ( $19.4 \pm 8.0$  ml).



**Figure 1** Correlation of thyroid volume and age in 483 male volunteers.

Goitre was present (**Table 1** and **Figure 2**) in 77 out of 204 smokers (37.7%) vs. 47/279 (16.8%) in non-smokers ( $p<0.001$ ) with an odds ratio of 3.0.



**Figure 2** Non-smokers taking iodine vs. non-smokers taking no iodine: OR=1.2, n.s. Non-smokers taking iodine vs. smokers taking iodine: OR=2.4,  $p=0.008$ . Non-smokers taking iodine vs. smokers taking no iodine: OR=4.9,  $p<0.001$ .

Smoking (<0.001) and increasing age ( $p<0.001$ ) associated with goitre prevalence by the logistic regression analysis but not the history of goitre in the first degree relatives (**Table 1**) and the iodine status failed just to reach the significant level in this analysis ( $p=0.056$ ).

**Table 1** Multivariate analyses of risk factors, age, BMI, smoking, iodized salt intake, family history of goiter on prevalence of goiter.

	no goitre	%	goitre	%	OR (CI)	p
N=483	359	74.3	124	25.7		
Age (mean) $\pm$ SD	41.8 $\pm$ 9.8		46.6 $\pm$ 8.1			$p<0.001$
BMI	26.1 $\pm$ 4.0		26.7 $\pm$ 3.7			n.s.
Thyroid volume $\pm$ SD	17.2 $\pm$ 3.9		33.0 $\pm$ 10.2			$p<0.001$
smokers	127	62.3	77	37.7	3.0 (2.0;4.6)	$p<0.001$
non-smokers	232	83.2	47	16.8		
No children	227	79.4	59	20.6	1.9 (1.3;2.9)	$p=0.003$
children	132	67.0	65	33.0		
No iodine salt	158	70.5	66	29.5	0.7 (0.4;1.0)	$p=0.056$
Iodine salt	188	78.3	52	21.7		(n.s.) pone sided= 0.034
No family history	294	74.2	102	25.8	1.0 (0.6;1.7)	n.s.
Family history	65	74.7	22	25.3		
Non-smokers taking no iodine	110	82.1	24	17.9		pooverall <0.001
Non-smokers taking iodine	112	84.8	20	15.2	0.8 (0.4;1.6)	n.s.
Smokers taking no iodine	48	53.3	42	46.7	4.9 (2.6;9.2)	$p<0.001$
Smokers taking iodine	76	70.4	32	29.6	2.4 (1.3;4.4)	$p=0.008$

P<0.05 was considered as significant level. OR (CI): odds ratios with the range of confidence interval

*Chi-square*-Test shows a higher prevalence of goitre among smokers who don't use iodine salt compared to smokers taking iodine regularly (29.6% vs. 46.7%,  $p=0.018$ ,  $p_{overall}<0.001$ ). Among the non-smoking individuals the frequency of goitre stays by 15.2% with iodine intake and by 17.9% without iodine (n.s.).

## Discussion

This study indicates smoking as the major risk factor for goitre in men. The median volume of thyroid in smokers was in general higher as compared to non-smokers. The risk of developing goitre in smoking men was approximately 3 times higher as compared to non-smokers. In addition, the prevalence of goitre in smokers was significantly lower in case of iodine intake.

Earlier investigations suggest that cigarette smoking may increase thyroid hormone secretion [18]. The first clinical record of association between smoking and goitre prevalence was published 1984. In this study Christensen et al. [11] evaluated the prevalence of goitre by palpation in 441 middle aged women and found higher goitre prevalence among

smokers (14.8%) as compared to ex-smokers (3.8%) and non-smokers (9.4%).

In 219 randomly selected hospital employees, Hegedus et al. [12] found a higher prevalence of goitre among smokers (30%) as compared to non-smokers (3%).

Berghout et al. [13] found no association between thyroid volume and smoking and no correlation between thyroid volume and tobacco consumption in an iodine-sufficient area.

Ericsson et al. [14] report in an epidemiological study from Sweden including more than 4000 subjects, a higher goitre prevalence among smoking females (14.2%) as compared to non-smokers (8.9%) and ex-smokers (7.0%).

Petersen et al. [15] found no increased prevalence of thyroid disease or goitre in 1154 middle-aged and older Swedish women with respect to smoking (14.3% smokers vs. 13.4% non-smokers).

Georgiadis et al. [16] investigated 187 employees of a hospital and their relatives and found goitrogen effect of smoking only in individuals with a family history of goitre.

However, these studies mostly or exclusively performed in female population, few suffer from insufficient number of subjects or inappropriate multivariate analysis of risk factors.

Knudsen et al. [17] report in a recent multivariate analysis on 4649 randomly selected sample of females and males (2002) on association between smoking and increased goitre prevalence, which was more pronounced in the most iodine deficient area.

The effects of smoking on the thyroid have been attributed to thiocyanate. Body fluid of smokers contains increased concentration of thiocyanate [19-22]. Thiocyanate inhibit iodide uptake and thyroid hormone synthesis and increase the efflux of iodide from the thyroid gland [22].

Indeed, recent improvement of iodine supplementation since 1989 reduced the prevalence of goitre especially in younger population [3-8], however, the prevalence of goitre in Germany remains substantial [9,10].

We conclude that smoking is an independent risk factor affecting the goitre prevalence in males. In addition, our study reveals that iodine intake can reduce the risk of goitre in smoker males significantly.

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