Evaluation of thyroid antibodies and benign disease prevalence among young adults exposed to ¹³¹I more than 25 years after the accident at the Chernobyl Nuclear Power Plant

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Background. The Chernobyl Nuclear Power Plant (CNPP) accident exposed a large number of inhabitants to internal ¹³¹I radiation. The associations between internal ¹³¹I exposure and thyroid autoimmunity and benign thyroid diseases remain controversial in the population living in the contaminated area around the CNNP. In this study, we evaluate the association of ¹³¹I with benign thyroid diseases. Methods. We compared the prevalence of anti-thyroid autoantibodies (ATAs), thyroid function, and prevalence of thyroid ultrasound finding outcomes in 300 residents of the contaminated area of Ukraine who were 0-5 years of age at the time of the CNPP accident (group 1) and 300 sex-matched residents who were born after the accident (group 2). Results. We did not find any differences of the prevalence of antithyroglobulin antibodies (TGAb) positive, antithyroid peroxidase antibodies (TPOAb) positive, and TGAb and/or TPOAb positive between the study groups. (11.7% vs 10.3%; p=0.602, 17.3% vs 13.0%; p=0.136, 21.0% vs 17.3%; p=0.254, respectively); after adjusting for age and sex, the prevalence was not associated with the ¹³¹I exposure status in the study groups. The prevalence of subclinical and overt hypothyroidism cases was not significantly different (p=0.093 and p=0.320) in the two groups, nor was the prevalence of goiter (p=0.482). On the other hand, the prevalence of nodules was significantly higher in group 1 (p=0.003), though not significantly so after adjustment for age and sex. Discussion. Working 26 to 27 years after the CNNP accident, we found no increased prevalence of ATAs or benign thyroid diseases in young adults exposed to ¹³¹I fallout during early childhood in the contaminated area of Ukraine. Long term follow-up is needed to clarify the effects of radiation exposure on autoimmunity reaction in the thyroid.

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27 Abstract

28	Background. The Chernobyl Nuclear Power Plant (CNPP) accident exposed a large number of
29	inhabitants to internal ¹³¹ I radiation. The associations between internal ¹³¹ I exposure and thyroid
30	autoimmunity and benign thyroid diseases remain controversial in the population living in the
31	contaminated area around the CNNP. In this study, we evaluate the association of ¹³¹ I with
32	benign thyroid diseases.
33	Methods. We compared the prevalence of anti-thyroid autoantibodies (ATAs), thyroid function,
34	and prevalence of thyroid ultrasound finding outcomes in 300 residents of the contaminated area
35	of Ukraine who were 0-5 years of age at the time of the CNPP accident (group 1) and 300 sex-
36	matched residents who were born after the accident (group 2).
37	Results. We did not find any differences of the prevalence of antithyroglobulin antibodies
38	(TGAb) positive, antithyroid peroxidase antibodies (TPOAb) positive, and TGAb and/or TPOAb
39	positive between the study groups. (11.7% vs 10.3%; $p=0.602$, 17.3% vs 13.0%; $p=0.136$,
40	21.0% vs 17.3%; $p=0.254$, respectively); after adjusting for age and sex, the prevalence was not
41	associated with the ¹³¹ I exposure status in the study groups. The prevalence of subclinical and
42	overt hypothyroidism cases was not significantly different ($p=0.093$ and $p=0.320$) in the two
43	groups, nor was the prevalence of goiter ($p=0.482$). On the other hand, the prevalence of nodules

44	was significantly higher in group 1 ($p=0.003$), though not significantly so after adjustment for
45	age and sex.
46	Discussion. Working 26 to 27 years after the CNNP accident, we found no increased prevalence
47	of ATAs or benign thyroid diseases in young adults exposed to ¹³¹ I fallout during early
48	childhood in the contaminated area of Ukraine. Long term follow-up is needed to clarify the
49	effects of radiation exposure on autoimmunity reaction in the thyroid.
50	
51	Key words: Benign thyroid disease, Thyroid autoimmunity, ¹³¹ I exposure, Chernobyl, radiation

53 Introduction

54	The Chernobyl Nuclear Power Plant (CNPP) accident on 26th April 1986 was the worst
55	nuclear disaster in history. The accident caused the release of a large amount of radionuclides into
56	the environment (United Nations Scientific Committee on the Effects of Atomic Radiation
57	(UNSCEAR), 2011). The fallout, which contained both short-lived radionuclides consisting
58	mostly of iodine-131(¹³¹ I) and long-lived radionuclides made up largely of cesium-137 (¹³⁷ Cs)
59	(Christodouleas et al., 2011), exposed a great number of inhabitants living in contaminated areas
60	now in Ukraine, Belarus, and the Russian Federation to internal radiation of the thyroid gland
61	through the ingestion of contaminated foods containing ¹³¹ I (UNSCEAR, 2011). Several years
62	after the accident, the incidence of childhood thyroid cancer had dramatically increased in the
63	population living in those areas and was strongly related to this ¹³¹ I exposure (Cardis et al., 2005;
64	Demidchik, Saenko & Yamashita, 2007; Zablotska et al., 2011). Between 1991 and 2005, 5,127
65	cases of thyroid cancer were reported in residents exposed as children under 14 years old in 1986
66	(6,848 cases in those under 18), according to the UNSCEAR report (2011).
67	On the other hand, several studies have been conducted regarding the relationship
68	between radiation exposure and thyroid autoimmunity and benign thyroid diseases, but the results

69 remain inconsistent (Ito et al., 1995; Vykhovanets et al., 1997; Pacini et al., 1998; Vermiglio et al.,

70	1999). Screening studies targeting individuals under 18 years old at the time of the accident showed
71	a significant association between thyroid ¹³¹ I dose and the prevalence of subclinical
72	hypothyroidism (Ostroumova et al., 2009; Ostroumova et al., 2013), but not with autoimmune
73	thyroiditis (AIT) (Tronko et al., 2006; Ostroumova et al., 2009; Ostroumova et al., 2013). Agate
74	et al. also reported a higher prevalence of thyroid dysfunction and TPOAb without autoimmune
75	thyroiditis in children living in the contaminated region 13-15 years after the accident, compared
76	to non-contaminated Belarusian settlements (Agate et al., 2008). Almost thirty years has passed
77	since the Chernobyl accident. The residents who lived through the accident in childhood are now
78	adults and the situation might have evolved. The purpose of this study was to evaluate the
79	association of internal radiation exposure to ¹³¹ I and the prevalence of anti-thyroid autoantibodies
80	(ATAs) and benign thyroid disease among young adults living in the contaminated area of Ukraine,
81	more than 25 years after the accident.

82 Material and Methods

This study was conducted primarily at the Korosten Inter-Area Medical Diagnostic Center ("the center"), Korosten, Zhitomir region, Ukraine. This area is located 120 km southwest of the CNPP and was heavily affected by the accident. The estimated average ¹³¹I thyroid doses in children and adolescents living in this region at the time of the accident was 0.15–0.65 Gy (UNSCEAR, 2011).

88 For study participants, we recruited two groups of young adults who visited the center 89 between June 2012 and January 2014 for their annual health screening. The first group consisted 90 of young adults (n=300) born between 1st January 1981 and 26th April 1986 (age 0-5 years on 26th 91 April 1986) who lived in the region at the time of the accident and were not evacuated (group 1). This group was considered to have experienced internal ¹³¹I radiation exposure. The second group 92 93 consisted of sex-matched young adults (n=300) born between April 1987 and December 1991 94 (more than one year after the accident) and residing in the Zhitomir region after the accident (group 2). This group was considered to have not experienced internal ¹³¹I radiation exposure; since the 95 half-life of ¹³¹I is about eight days, the ¹³¹I had decayed within a few months after the accident and 96 any effect of ¹³¹I should have been extremely low when they were born. Young adults who had a 97 98 history of thyroid cancer or had undergone thyroid lobectomy were excluded. The study protocol

99	was approved by the center's Institutional Review Board (No.002) and the ethical committee of
100	Nagasaki University Graduate School of Biomedical Sciences (No.12122865). Prior to the study,
101	written informed consent was obtained from all participants.
102	Blood samples were collected for measurement of free triiodothyronine (FT3), free
103	thyroxin (FT4), thyroid-stimulating hormone (TSH), antithyroglobulin antibodies (TGAb), and
104	antithyroid peroxidase antibodies (TPOAb). Serum FT ₃ , FT ₄ , TSH, TGAb, and TPOAb levels were
105	measured using a Stat Fax® 303 Plus enzyme-linked immunosorbent assay (ELISA) (Awareness
106	Technology, Inc., Palm City, FL). The laboratory reference range for FT3, FT4, and TSH were
107	1.4–4.2 ng/ml, 0.8–2 ng/ml, and 0.3–6.2 $\mu IU/ml$, respectively. TGAb values < 8 IU/ml and TPOAb
108	values < 20 IU/ml were considered negative. We defined overt hypothiroidism as freeT4 < 0.8
109	ng/dl and TSH > 6.2 $\mu IU/ml$ and subclinical hypothyroidism as freeT4 ≥ 0.8 ng/dl and TSH > 6.2
110	μIU/ml.
111	Ultrasonography of the thyroid gland was performed in both groups using 8.5 MHz
112	Nemio XG SSA-580A probes (Toshiba, Tokyo, Japan). Presence of nodules, cysts, and
113	echostructure were recorded. The thyroid volume was calculated based on the formula, length *

- 114 width * depth * 0.479 described by Brunn et al (1981). Finally, we defined goiter as thyroid volume
- 115 larger than 25 ml in men and 18 ml in women.

The ¹³⁷Cs body burdens in both groups were measured using a whole-body counter (γspectrometer, model 101, equipped with a collimator; Aloka Co., Ltd., Tokyo, Japan). The detectable ¹³⁷Cs body burden was 270 Bq/body. Participants who did not have any ¹³⁷Cs exposure were defined as be "0 Bq."

120 Data are expressed as means plus standard deviations (SDs) and medians. Differences in age, FT3 and FT4 concentrations, and thyroid volumes between groups were evaluated using t-121 122 tests. TSH concentration was distributed in a skewed manner, so logarithmic transformation was performed for the analysis. FT3 and FT4 concentrations adjusted for age and thyroid volumes 123 124 adjusted for body weight were compared by analysis of covariance between the groups. The difference between groups for ¹³⁷Cs body burden was evaluated by a Mann-Whitney's U-test. 125 Frequencies of positive TGAb, TPOAb, thyroid nodules, and goiter were evaluated using the γ^2 -126 127 test. Frequencies of hypothyroidism were evaluated using Fisher's exact test. We used logistic 128 regression analysis to assess the association between the prevalence of ATAs, goiter, and nodules and ¹³¹I exposure, age, and sex. All statistical analyses were performed using SPSS software, v.22 129 130 for Mac (SPSS Japan, Tokyo, Japan). P values of less than 0.05 were considered statistically 131 significant.

133 **Results**

134	The characteristics of participants, functional thyroid outcomes and ¹³⁷ Cs body burdens
135	are summarized in Table 1. The mean age of group 1 and group 2 was 28.3 and 23.0 years old at
136	examination, respectively. Each group included 237 females (79%). The median ¹³⁷ Cs body burden
137	was below the detection limit in both groups, and no significant difference was noted between the
138	groups ($p=0.261$). Most participants had FT3 and FT4 concentrations within the normal range, but
139	FT4 concentrations were significantly higher in group 2 ($p=0.014$) and FT3 concentrations
140	adjusted for age were significantly higher in group 2 ($p=0.016$). Median TSH concentrations in
141	groups 1 and 2 were 1.08 $\mu IU/ml$ and 1.22 $\mu IU/ml$, respectively, but this difference was not
142	statistically significant ($p=0.183$). A few subclinical or overt hypothyroidism cases were observed,
143	all of them were ATA-positive. The prevalence of subclinical hypothyroidism was not
144	significantly different between the groups ($p=0.093$). Only three and one overt hypothyroidism
145	cases were observed in group 1 and group 2, respectively; the prevalence was also not significantly
146	different ($p=0.320$).

147 The prevalence of TGAb positive or TPOAb positive was not significantly higher in 148 group 1 than in group 2 (TGAb positive: 11.7% vs 10.3%; p=0.602, TPOAb positive: 17.3% vs 149 13.0%; p=0.136, respectively, Figure 1). The prevalence of TGAb and/or TPOAb positive was

150	also not significantly different (21.0% vs 17.3%; $p=0.254$). Logistic regression analysis adjusted
151	for age and sex showed that only female gender was significantly correlated with TGAb, TPOAb,
152	and TGAb and/or TPOAb positive prevalence (Table 2).
153	The mean thyroid volume was 15.93 ml for group 1 and 15.74 ml for group 2, with no
154	significant difference of prevalence of goiter in the two groups (25.3% vs 26.7%; $p=0.780$, Fig 2).
155	The prevalence of thyroid nodules was significantly higher in group 1 (16.3% vs 8.3%; $p=0.003$);
156	however, logistic regression analysis adjusted for age and sex showed that ¹³¹ I exposure status was
157	not correlated with nodule prevalence (OR=0.782, 95%CI 0.263-2.320, p =0.657), while age and
158	female gender were significantly correlated with nodule prevalence (Table 3).
159	
160	Discussion
161	In this study, we evaluated the association between internal ¹³¹ I exposure and the
162	prevalence of ATAs, thyroid function, and thyroid ultrasonography outcomes among young adults
163	living in the contaminated area of Ukraine.
164	The positive impact of this study was to evaluate the relationship between the experience
165	of internal ¹³¹ I exposure in childhood and the occurrence of thyroid diseases more than 25 years
166	after the accident. Additionally, by recruiting study participants who all lived in the same area, we

- 167 were able to compare two groups that had similar internal ¹³⁷Cs exposure levels and iodine status,
- 168 which could have confounding effects on thyroid outcomes.
- 169 Several ecological studies conducted approximately 10 years after the accident have 170 reported that prevalence of positive TPOAb and TGAb was significantly higher in children living in areas around the CNPP with greater contamination (Vykhovanets et al., 1997; Pacini et al., 171 172 1998; Vermiglio et al., 1999). On the other hand, a screening study conducted among 160,000 children aged 0-10 years at the time of the accident and living around the CNPP between 1991 173 and 1996 (5 to 10 years after the accident) within the framework of the Chernobyl Sasakawa Health 174 175 and Medical Cooperation Project reported no significant relationship between the prevalence of TGAb and radiation exposure dose estimated by ¹³⁷Cs body burden or with soil ¹³¹Cs 176 177 contamination levels at sites where study participants were living (Saiko et al., 1997). Agate et al. 178 recently evaluated the prevalence of positive TPOAb and TGAb and TSH concentrations in residents living in contaminated and non-contaminated areas of Belarus, Ukraine, and the Russian 179 180 Federation 13 to 15 years after the accident, finding that the prevalence of positive TPOAb was 181 significantly higher in adolescents exposed to radioactive fallout in Belarus, though not in Ukraine 182 and the Russian Federation (Agate et al., 2008). In our study that conducted more than 25 years 183 after the accident, we also did not find any significant difference in ATA prevalence between

184	young adults in Ukraine exposed to radioiodine in childhood and young adults without exposure.
185	We showed that FT3 concentration adjusted for age was significantly higher in group 2,
186	but did not find any significant increase in TSH concentration or in the prevalence of antibody-
187	positive hypothyroidism in group 1. There are large cohort studies that reported the relationship
188	between radiation exposure due to ¹³¹ I by the accident at CNNP and hypothyroidism. Ostroumova
189	et al. reported screening studies conducted in Ukraine and Belarus 10-17 years after the accident
190	in individuals under the age of 18 years at the time of the CNPP accident, showing a significant
191	association between ¹³¹ I thyroid dose and the prevalence of subclinical hypothyroidism. However,
192	excess odds ratio was higher in individuals with TPOAb \leq 60 U/ml than in those with TPOAb $>$
193	60 U/ml in both studies (Ostroumova et al., 2009; Ostroumova et al., 2013). In same study of
194	Ukraine, Tronko et al. did not find any association between ¹³¹ I thyroid dose and the prevalence of
195	autoimmune thyroiditis, but the prevalence of elevated ATPO demonstrated a modest, significant
196	association with ¹³¹ I that was well described by several concave models (Tronko et al., 2006). As
197	ecological study, Agate et al. reported that ATA prevalence in exposed Belarusian adolescents 13
198	to 15 years after the accident was much lower than the rate in their previous study of 6 to 8 years
199	after the accident, suggesting a transient autoimmune reaction that did not trigger autoimmune
200	disease and had no effect on thyroid function (Pacini et al., 1998; Agate et al., 2008). In our study,

201 sample size was small so that a careful evaluation is needed, but we did not find a significant increase of antibody-positive/negative hypothyroidism in the group exposed to ¹³¹I in their 202 203 childhood, 25 years after the accident in Ukraine. The thyroid immune reaction to radiation exposure remains obscure. In atomic bomb survivors exposed to acute gamma radiation, a convex 204 dose-response relation with antibody-positive hypothyroidism was observed (Nagataki et al., 205 206 1994), but was not found in a more recent study (Imaizumi et al., 2006). Hence, the autoimmune 207 reaction to radiation exposure in thyroid may change over time, so that further long-period observation is needed to evaluate fully the dynamic of any relationship between radiation exposure 208 209 and hypothyroidism and autoimmunity reaction in the thyroid. 210 Several studies on the role of radiation in the development of thyroid nodules among the

cohorts of medically irradiated patients, residents exposed to fallout from nuclear testing, or atomic bomb survivors have been published (Ron & Brenner, 2010). Imaizumi et al. reported that among atomic bomb survivors, a significant linear dose-response relationship was observed for the prevalence of all solid nodules, not only malignant tumors, but also benign nodules and cysts (Imaizumi et al., 2006). On the other hand, in the Hanford nuclear test site study, there was no evidence that the incidence of benign thyroid nodules increased with dose (p=0.68), with an estimated slope of -0.8%/ Gy (95% CI, <-2.2%/ Gy to 4.1%/ Gy) (Davis et al., 2004). In the

218	present study, the prevalence of thyroid nodules was significantly higher in group 1, but this
219	difference disappeared after adjustment for age and sex. Age and sex are important factors
220	influencing the development of benign thyroid nodules, and it has been reported that, even among
221	people in their twenties, the prevalence of thyroid nodule is higher in female and older age cohorts
222	(Reiners et al., 2004). In the Chernobyl Sasakawa Health and Medical Cooperation Project, the
223	prevalence of thyroid nodules was also age-dependent and higher in girls than in boys, a fact that
224	explains their higher incidence in older age groups (Panasyuk et al., 1997). In the present study,
225	as the number of females was the same in both groups, the increase of thyroid nodule prevalence
226	in group 1 might be due to aging rather than ¹³¹ I exposure in their childhood.
227	In the present study, we have shown that female gender was significantly correlated with
228	ATA prevalence and that age and female gender were significantly correlated with goiter. It is well
229	known that aging and female gender are risk factors of high prevalence of ATAs and goiter
230	(Hollowell et al., 2002; Reiners et al., 2004; Hoogendoorn et al., 2006).
231	This study has several limitations. The number of subjects was relatively small since it
232	was conducted only among the population residing in Ukraine's Zhitomir region and visiting the
233	center for an annual health screening. As a reference, in the framework of the Chernobyl Sasakawa
234	Health and Medical Cooperation Project, around 18,000 children aged 0-5 years old at the time of

235	the accident were screened at the center from 1991–1996 (Yamashita & Shibata, 1997). Therefore,
236	we screened around 1.6% of the number of patients who accessed the center in 1991–1996.
237	Additionally, there might be a bias in the selection of study participants, as this study's subjects
238	were those residents who chose to visit the center and undergo health screening. Therefore, we
239	need to evaluate carefully whether our data can be generalized to all eligible residents. We also
240	could not evaluate individual thyroid doses because the data of thyroid dose was not available.
241	However, The estimated average ¹³¹ I thyroid doses in children living in this region at the time of
242	the accident was reported as 0.15–0.65 Gy (UNSCEAR, 2011). And there is a ultrasound screening
243	study of Belarusian school children living within 150km of the CNNP showed high rates of thyroid
244	cancer in those who were bone before the accident (exposed group; $n=31/9720$, 0.32%), while no
245	thyroid cancer was seen in those who were bone after the accident (unexposed group; $n=0/2409$)
246	(Shibata et al., 2001). This result suggested that the fallout of short-lived radionuclides from the
247	CNPP accident affected to children who were bone before the accident but did not affect to children
248	who were bone after the accident. Therefore, we considered that it might be possible to evaluate
249	the relationship between the experience of exposure to ¹³¹ I in childhood and prevalence of ATA
250	and thyroid benign diseases even though the individual thyroid dose were not available.

251

In conclusion, we showed no increased prevalence of ATAs and benign thyroid diseases

- 252 more than 25 years after the CNPP accident in young adults exposed to ¹³¹I fallout during their
- 253 childhood. Long term follow-up in the population living around the CNPP is needed to clarify the
- 254 effects of radiation exposure on the autoimmunity reaction in the thyroid.

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355 Figure Legends

356

357 Fig.1 Prevalence of thyroid ATAs in group 1 and group 2. The prevalence of TGAb, TPOAb and

358 TGAb and/or TPOAb was slightly but not significantly higher in group 1 than group2.

359

360	Fig.2 Prevalence of thyroid ultrasound findings outcomes. No significant difference in diffuse
361	goiter prevalence was found between the groups (25.3% vs 26.7%; $p=0.780$). On the other hand,
362	the prevalence of nodules was significantly higher in group 1 (16.3% vs 8.3% ; $p=0.003$). However,
363	logistic regression analysis adjusted for age and sex showed that age and female gender were
364	correlated with goiter and nodule prevalence.
365	

Table 1(on next page)

Characteristic and thyroid outcomes of study groups

- 1 Table 1. Characteristics and thyroid outcomes of study groups
- 2

Group 1		Group 2		adjusted
	Group 1	Group 2	<i>p</i> value	adjusted
	(n=300) (n=300)			<i>p</i> value
Age				
	28.3±1.4	23.0±1.4	< 0.001	-
(at the examination)				
Female, n (%)	237 (79)	237 (79)	-	-
Free T3, pg/ml	2.66±1.18	2.75±0.99	0.333	0.016*
Free T4, ng/dl	1.33±0.39	1.39±0.30	0.014*	0.074
TSH, μIU/ml,	1.08 (0.76-1.75)	1.22 (0.81-1.77)	0.183	_
Log(TSH)	0.02±0.44	0.04±0.40	0.308	0.602
Overt				
	3	1	0.320	-
hypothyroidism, n				
Subclinical			0.093	
	7	2		-
hypothyroidism, n				
Thyroid volume, ml	15.93±7.00	15.74±5.29	0.718	0.204

¹³⁷ Cs body burden,	0	0		
Bq/kg	(0-49.65)	(0-159.34)	0.261	-

3

4	Age, FreeT3, FreeT4, log TSH and thyroid volume are shown as mean±SD. TSH is shown as
5	median(IQR) and ¹³⁷ Cs body burden is shown as median (minimum-maximum). FreeT3, FreeT4
6	concentrations and log-TSH were adjusted for age and thyroid volume was adjusted for body
7	weight between the groups were compared by analysis of covariance.
8	*p<0.05
9	



Table 2(on next page)

Logistic regression analysis of examined variables: 131I exposure, sex and age at examination.

2

	TGAb		TPOAb		TGAb and/or TPOAb	
Values	OR	<i>P</i> value	OR	P value	OR	P value
values	(95%CI)		(95%CI)		(95%CI)	
¹³¹ I exposure	2.029	0.214	2.529	0.062	1.943	0.144
(group1/group2) (0.664-6.193) 0.2		0.214	4 (0.953-6.711) 0.062	0.062	(0.797-4.738)	0.144
Sex	9.762	0.002*	2.749	0.006*	3.775	~0.001*
(female/male)	(2.355-40.472)		(1.338-5.648)	0.000*	(1.852-7.698)	~0.001*
Age at	0.889	0.260	0.896	0 194	1.943	0.144
examination	(0.747-1082)		(0.762-1.054)	0.164	(0.797-4.738)	0.144

Table.2 Logistic regression analysis of examined variables: ¹³¹I exposure, sex and age at 1 examination

3 * P<0.05



Table 3(on next page)

Logistic regression analysis of examined variables: 131I exposure, sex and age at examination.

- 1 Table 3. Logistic regression analysis of examined variables: ¹³¹I exposure, sex and age at
- 2 examination
- 3

	Nodule		Goiter		
Values	OR	Durahua	OR	Devalue	
values	(95%CI)	P value	(95%CI)	P value	
¹³¹ I exposure	0.782	0.657	2.085	0.072	
(group1/group2)	(0.263-2.320)	0.037	(0.937-4.638)	0.072	
Sex	2.827	0.012*	2.323	0.002*	
(female/male)	(1.257-6.357)	0.012*	(1.369-3.941)	0.002*	
Age at	1.212	0.020*	0.860	0.02(*	
examination	(1.011-1.452)	0.038*	(0.752-0.982)	0.020*	

4 * P<0.05



1

Prevalence of thyroid ATAs in grope1 and group2.

Prevalence of thyroid ATAs in grope1 and group2. The prevalence of TGAb, TPOAb and TGAb and / or TPOAb was slightly but not significantly higher in group1 compared with group2.



2

Prevalence of thyroid ultrasound findings outcomes.

No significant difference of diffuse goiter prevalence was observed in both groups (19.7% vs 22.0%; p=0.482). On the other hand, the prevalence of nodules was significantly higher in group1 (16.3% vs 8.3%; p=0.003). However Logistic regression analysis adjusted by age and sex showed that age and female gender were correlated with goiter and nodule prevalence.

