Estimation of thyroid volume in children from oil–gas producing areas of West Kazakhstan

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Research Article
**Estimation of thyroid volume in children from oil–gas producing areas of West Kazakhstan**

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**Abstract**

The aim of investigation was to estimate the volume of thyroid determined by US in schoolchildren aged 7-11 living in oil–gas producing regions of West Kazakhstan. 815 schoolchildren aged 7-11 were examined according to WHO Protocols. Goiter prevalence was 24.7 ± 1.50%, 44.6 ± 2.59% of them in oil producing regions and 8.3 ± 1.3% in ecologically clean areas. Significant difference in the median of thyroid volume between boys (5.4 mπ) and girls (4.8 mπ) in oil–gas districts (z = 2.65; p < 0.01) and in whole region (z = 16.96; p < 0.001) was noticed. Median and 97 percentile of thyroid volume of our tested were higher than the standard values reported by WHO.

**Keywords:** Goiter; West Kazakhstan; oil–gas producing regions; thyroid volume; ultra scanning.

**Introduction**

According to WHO data, more than 2 billion people all over the world have risk of developing iodine deficiency diseases. Iodine deficiency, besides increase in thyroid volume, leads to intellect decrease, mental and physical development delay, aggregates somatic pathology in children and teenagers, results in reduction of potential and is a global problem of public health of the world [1-4]. Analysis made on primary disease incidence with thyroid in West Kazakhstan for the last 5 yrs showed steady growth of thyroid pathology including acquired and congenital hypothyroidism [5].

WHO defined clinical (goiter rate) and biochemical (the median of iodine concentration in the urine) criteria to estimate endemic intensity. Although palpation is simple, size definition by means of US is more preferable because of subjective factors, poor sensation, and palpation specificity [1]. In 2003, international normatives of thyroid volume were established [6]. Nevertheless, generally accepted standard values for thyroid volume in terms of adequate intake of iodine is the issue [7-9].

At present, entire territory of Kazakhstan can be referred to regions with average and slight iodine deficiency. According to the data by Kazakh Nutrition Academy in 1999, 60% women of reproductive age in all regions of Kazakhstan had different levels of iodine deficiency, from 4.0 to 12.0% of them experienced severe form of iodine deficiency. It should be underlined that according to multi-indicator cluster investigation conducted by Kazakh Nutrition Academy in 2006 with the support of UNICEF, iodine prevalence among women of reproductive age reduced in fourfold in comparison with those in 1999 and composed 15%. Today universal way of adding iodine to nutritional and fodder salt is regulated by the Law of Kazakhstan on Prevention iodine deficiency diseases dated from 14.10.2003. No. 489 – Public Health of Republic of Kazakhstan. Nevertheless, in spite of carried work to prevent iodine deficiency diseases goiter incidences still remains higher among schoolchildren in West Kazakhstan [10,11].

High prevalence of goiter, strumogenic factors’ impact on endemic development served the basis for conducting this investigation.

The aim of work was the estimation of the thyroid volume determined by US in schoolchildren aged 7-11 living in oil–gas producing regions of West Kazakhstan.
Materials and Methods

After having approval by local Ethic Committee of West Kazakhstan State Medical University of Marat Ospanov (Protocol #06/01-7 dated 05.01.2013), investigation was conducted to schoolchildren between 7 and 11 yrs old.

Research was done within 30-cluster analysis on goiter prevalence in Aktobe region. Research methodology met protocol requirements, recommended by WHO on endemic goiter studies [1]. Population areas where oil and gas are produced were selected on the basis of data by Regional Statistic Department. Equal amount of ecologically clean areas related to agricultural districts were selected by randomized study as a control group. Schools were also selected by randomized study. In these schools children from 3 to 4 of primary school who are the permanent residents of this district were examined by overall method. All demographic findings (gender, age, weight, and height) were recorded. Height and weight were defined by standard method. US of thyroid was done by a qualified specialist according to the generally accepted recommendations. Ultra scanning apparatus Aloka SSD-500 (Japan) with 7, 5 detector was used. The size of thyroids and standard normatives of thyroids in children were determined and estimated depending on body surface area and gender according to WHO recommendations (2007) [1,6]. It should be noted that in ultra scanning examination, thyroid is considered enlarged (goiter) if its volume exceeds 97 percentile of volume, revealed in people with good iodine supply.

Group distribution and characteristics on age, gender, body mass index (BMI) are presented in Table 1.

Statistic Methods

Statistic processing of findings was done in SAS Program, version 9.2. Normality of distribution was assessed according to Kolmogorov–Smirnoff criteria. Research results are presented in the average meaning (M), standard decline (SD), in case of abnormal distribution in the meaning of medium (Me). Two T-tests with various dispersion (t) and Wilcoxon criteria (z) were used to estimate statistic significance of difference. Correlative analysis was conducted with Pirson and Spirman's coefficient correlation. Criteria corresponding to \( p < 0.05 \) were considered significant.

This research was conducted according to international requirements for clinical experiences (GCP). The research work was conducted at finance allocated by the Ministry of Health RK in the period of 2013-2015 for research on the theme “Epidemiology of endemic goiter in the west region of Kazakhstan and designing recommendations on prophylaxis of iodine deficiency”. Registered number RTI RK: 013PK00439.

Results and Discussion

The most significant criteria of goiter in investigation are thyreomegaly frequency. Goiter prevalence in our sampling by using 97 percentile of the volume, recommended by WHO/ICCIDD (2007) composed 24.7 ± 1.50% (49.8% in girls and 50.2% in boys), 44.6% of whom were from oil–gas producing districts and 8.3 ± 1.3% lived in ecologically clean areas. Analysis on the difference of goiter prevalence demonstrated that children living in clean districts had less thyreomegaly than those who were from oil–gas producing areas (Figure 1).

If 89 (54.3%) of 164 children with goiter in oil–gas producing district were boys and 75 (45.7%) of them were girls then in ecologically clean areas among 37 children, goiter was noticed in 11 (29.7%) boys and 26 (70.3%) girls. Analysis made on goiter prevalence according to gender revealed that in oil–gas districts (t = 1.56; \( p > 0.05 \)) and all over the district (t = 3.88; \( p < 0.05 \)).

<table>
<thead>
<tr>
<th>Gender (boys/girls)</th>
<th>Age (M ± SD)</th>
<th>Height (cm) (M ± SD)</th>
<th>Weight (kg) (M ± SD)</th>
<th>Body mass index (kg/m²) (M ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oil–gas regions</strong> (n = 368)</td>
<td>52.4%/47.6%</td>
<td>8.35 ± 0.9</td>
<td>129.41 ± 6.8</td>
<td>27.27 ± 4.8</td>
</tr>
<tr>
<td><strong>Ecologically clean areas</strong> (n = 447)</td>
<td>47.7%/52.3%</td>
<td>8.68 ± 0.7</td>
<td>130.77 ± 6.6</td>
<td>28.07 ± 5.4</td>
</tr>
<tr>
<td><strong>Total region</strong> (n = 2257)</td>
<td>47.8%/52.2%</td>
<td>9.20 ± 1.2</td>
<td>133.58 ± 9.2</td>
<td>30.11 ± 7.5</td>
</tr>
</tbody>
</table>

Note: *Findings of 30th cluster analysis of goiter prevalence in the region.
goiter was noticed in boys whereas in clean areas more girls developed goiter ($t = 3.82; p < 0.001$).

In west Kazakhstan, several technogenic zones of pollution of different genesis were formed. Results of completed research showed that the content of chromium, nickel, lead near chromium factories, and sulfide vanadium from oil manufactures exceeded in ground, water, and other environment [12].

30th cluster analysis of goiter prevalence in Aktobe in 2013 revealed that goiter rate composes in average 42.8%. According to epidemiologic criteria defined by WHO and International Council controlling iodine deficiency diseases, the index of goiter incidence among school-children between 6 and 12 age groups which is equal or exceeding 5% shows the presence of iodine deficiency [1,11]. On the basis of criteria estimating the severity of iodine deficiency, recommended by WHO, goiter endemic of severe form was noted in the region.

Moreover, studies on received findings proved that high prevalence of goiter was noticed not only in oil–gas producing districts (44.6%), which exceeds sporadic level of sickness rate in 10 times but also in ecologically clean areas where by WHO criteria goiter endemic of slight intensity (8.3%) was noted.

Results of our work admit that endemy might be due to increased content of xenobiotics in environment, in this case wastes from oil–gas processing. Continuous living in areas polluted with products of technogenic origin leads to misbalance in microelements, together with slight iodine deficiency in environment contributes to significant growth of thyroid pathology [13]. Comparative analysis on medium difference of general thyroid volume showed exact difference in indices between oil–gas and ecologically clean districts ($z = 15.49; p < 0.001$); between ecologically clean districts and region according to 30 cluster analysis ($z = 16.85; p < 0.001$).

Received analysis demonstrated significant difference in medium of general thyroid volume between boys (5.4 ml) and girls (4.8 ml) in oil–gas producing districts ($z = 12.65; p < 0.001$) and in whole region ($z = 16.96; p < 0.001$).

Further, we compared average value of thyroid volume. Depending on living areas of children indices had statistic exact difference ($p < 0.0001$), and in oil–gas areas composed $4.43 \pm 1.66$ ml and $2.9 \pm 1.24$ ml in ecologically clean districts. While comparing thyroid volume in boys, exact difference ($p < 0.0001$) between indices in oil–gas districts ($4.62 \pm 1.75$) and clean areas ($2.78 \pm 0.93$) was revealed. These tendencies were also noticed in girls ($p < 0.0001$). Thyroid volume in girls from oil–gas producing districts was larger ($4.23 \pm 1.53$) in comparison with in those who live in clean districts ($3.05 \pm 1.52$).

It is generally known that in countries where children suffer from poor protein supply,
according to WHO recommendations, due volume of thyroid must be defined into taking consideration body surface area. The research shows that thyroid volume, in case of body surface area, is more larger than the volume estimated according to age [14]. Significant differences were revealed by other researchers while estimating thyroid volume in children according to various criteria [15]. Nevertheless, it is recommended to use criteria based on body surface area as it allows to estimate individual constitution characteristics of child’s development [7].

We also conducted comparative analysis on the thyroid volume (97 percentile) depending on the age of children. Presented Figures 2 and 3 clearly show that all indices of thyroid volume is higher than indices recommended by WHO as a normative value in boys as well as in girls.

Our results are agreed with research conducted in China [16]. In all studied groups with increasing ages, gap between thyroid indices recommended by WHO and the indices which we obtained is increasing. Detailed analysis revealed that in oil producing areas the

**Figure 2:** Comparison of thyroid volume in boys of different age in the investigated region with 97 percentile reported by WHO.

![Figure 2](image)

**Figure 3:** Comparison of thyroid volume in girls of different age in the investigated region with 97 percentile reported by WHO.

![Figure 3](image)
most negative values are noticed in boys aged 11 (difference to WHO indices is 3.16 ml) when this difference in girls is 2.47 ml. In ecologically favorable districts indices both in boys and girls meet WHO requirements. If forthcoming intensive phase of puberty is taken into consideration, one can assume that the number of children with thyrseomegaly will increase in several times and consequences of formation of reproductive function in children, especially in boys are supposed to be negative.

Average indices of height, weight, body mass index, body surface area were higher in ecologically clean areas in comparison with oil–gas districts, which is quite explainable. Analysis on correlation of general thyroid volume with anthropometric findings and children’s age demonstrated that there is poor link with only body mass index \( r = 0.3; p < 0.0001 \).

On the whole, according to the research results, the median of the iodine concentration of in the urine was 193.9 ± 86.1 mkg/l in 81 children, which indicates appropriate iodine supply of population in these regions.

It is known that thyroid enlargement remains up to 4 yrs after introducing program on usage of iodine salt [17]. Research results conducted by Kazakh Nutrition Academy in 2006, share of households consuming iodine salt reach 92%, median of concentration of iodine in urine is 235.9 ± 166.8 mkg/l, on the basis of which Kazakhstan is related to the group of countries where the aims to remove iodine deficiency in nutrition were achieved [10,18]. Hence, high goiter incidence in oil–gas producing districts is, probably, due to the impact of other factors, particularly misbalance of microelements, nutrition specificity, strumogenic factors of xenobiotics.

Conclusions

1. In west region of Kazakhstan, as a sample Aktobe, goiter endemic of severe form is noticed (42.8%).
2. The size of thyroid in schoolchildren of Aktobe region is higher than the standard values reported by WHO.
3. High prevalence of goiter in oil–gas producing districts (44.6%) on the background of appropriate iodine supply which was known as a result of studies on iodine concentration in the urine assumes the influence of other factors causing goiter in this region and needs further studies.

References


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