Update/Le Point

Recommended normative values for thyroid volume in children aged 6–15 years*

World Health Organization & International Council for Control of Iodine Deficiency Disorders

Inspection and palpation are the traditional methods used to determine thyroid volume in areas of moderate-to-severe iodine deficiency. However, in areas of mild endemicity, and generally whenever goitres are small, ultrasonography is a safe, noninvasive technique that provides a more precise and objective method for determining thyroid volume. Ultrasonography should be undertaken by well-trained operators, whose correct interpretation relies on the availability of standardized reference criteria from populations whose iodine status is known to be adequate. A recent survey conducted among schoolchildren aged 6–15 years in 12 European countries provides ultrasound data for determining thyroid volume from 7599 subjects, and urinary iodine levels from 5709 subjects. A subgroup of 3474 children born and living in areas where iodine intake is normal — as evidenced by median urinary iodine above 100 μg/l — furnishes data from which to derive thyroid volume reference values. This article presents the upper normal limit for thyroid volume, according to age, for the iodine-replete boys and girls in this subgroup, assessed using ultrasonography. In countries with a high prevalence of child growth retardation, thyroid volume is provisionally considered to be more directly a function of total body surface area. Recommended upper normal limits of thyroid volume, calculated according to body surface area, are also reported. These cut-off values are recommended for interpreting survey and surveillance ultrasonography data among school-age children.

Inspection and palpation are the traditional methods used to determine thyroid volume. In areas of moderate-to-severe iodine deficiency, interobserver variations in performing this assessment are usually low; however, in areas of mild endemicity, and generally whenever goitres are small, i.e. grade 1 or bordering on either grade 0 or grade 2, interobserver variations can be as high as 40%. Ultrasonography is a safe, noninvasive technique that provides a more precise and objective method of determining thyroid volume than inspection and palpation, particularly in areas where rates of goitre are low.

Ultrasonography should be undertaken by well-trained operators, who are able to perform up to 200 examinations a day. Since the interpretation of the results is to some extent subjective, before using this method it is important that operators participate in a calibration exercise with an experienced team. Several training programmes have been organized internationally to foster a standardized technique and interpretation of results.

Correct interpretation of ultrasonography also relies on the availability of standardized reference criteria from populations whose iodine status is known to be adequate, i.e. where average intake is $\geq 150\,\mu g$ per person per day and median urinary iodine is $>100\,\mu g/l$. Since thyroid size varies by age and body height and weight (*1*), derivation of normative values intended for universal application needs to be based on both these variables.

WHO and the International Council for Control of Iodine Deficiency Disorders (ICCIDD) recommend that community iodine status be monitored by

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[a] ThyroMobil Study Group. Principal investigator: Professor F. Delange, Executive Director, ICCIDD, Brussels, Belgium. Support for the ThyroMobil project in Europe was provided by Merck KGaA, Darmstadt, Germany.

focusing surveillance efforts on children aged 6–12 years (*2*). A recent survey[a] conducted among school-children aged 6–15 years in 12 European countries provides ultrasound data for determining thyroid volume based on 7599 subjects, and urinary iodine levels from 5709 (*3*). Thyroid volume reference values were derived using data from a subgroup of 3474 children (1793 boys and 1681 girls) born or living in areas where iodine intake is normal — as evidenced by median urinary iodine levels >100 µg/l. The same investigator performed all ultrasonography, and a single laboratory was responsible for all urinary iodine determinations. The children were from 23 localities in Austria, France, Netherlands, and Slovakia. Analysis of the data confirmed that there was no difference in thyroid volume between sites and countries where iodine intake had been corrected for more than 10 years (Austria and Slovakia) or more recently (France and Netherlands).

Table 1 presents the upper normal limit for thyroid volume, by age, for iodine-replete boys and girls in the study populations, assessed using ultrasonography. However, in countries with a high prevalence of child growth retardation, the limits for thyroid volume shown are unsuitable. In such cases, thyroid volume is provisionally considered to be more directly a function of total body surface area, which is calculated using the following formula (*4*):

$$\text{Body surface area (m}^2\text{)} = W^{0.425} \times H^{0.725} \times 71.84 \times 10^{-4}$$

where W is the weight in kg and H, the height in cm.

Recommended upper normal limits of thyroid volume, calculated according to body surface area, are shown in Table 2.

Table 1: **Upper limit of normal thyroid volume measured by ultrasonography in iodine-replete children aged 6–15 years as a function of age**

Age (years)	Thyroid volume (ml): Boys	Girls
6	5.4	5.0
7	5.7	5.9
8	6.1	6.9
9	6.8	8.0
10	7.8	9.2
11	9.0	10.4
12	10.4	11.7
13	12.0	13.1
14	13.9	14.6
15	16.0	16.1

Table 2: **Upper limit of normal thyroid volume measured by ultrasonography in iodine-replete children aged 6–15 years as a function of body surface area**

Body surface area (m^2)	Thyroid volume (ml): Boys	Girls
0.8	4.7	4.8
0.9	5.3	5.9
1.0	6.0	7.1
1.1	7.0	8.3
1.2	8.0	9.5
1.3	9.3	10.7
1.4	10.7	11.9
1.5	12.2	13.1
1.6	14.0	14.3
1.7	15.8	15.6

Ultrasonography and measurement of urinary iodine levels are becoming increasingly important for monitoring the sustained impact of measures for controlling iodine deficiency disorders, notably salt iodization programmes. In this connection, WHO and ICCIDD recommend that the cut-off values given in Table 1 and Table 2 be used as a reference for interpreting survey and surveillance ultrasonography data among school-age children.

Fig. 1 shows the changes of thyroid volume measured by ultrasonography in the subgroup of iodine-replete children as a function of sex and age, and Fig. 2 as a function of sex and body surface area.

Fig. 1. **Changes in thyroid volume, by sex and age, in iodine-replete children in Europe** (P50 = 50th percentile, i.e. median; P97 = 97th percentile, i.e. upper limit of normal). See ref. *3*.

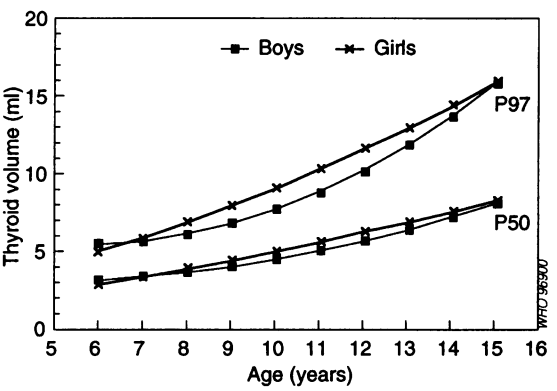
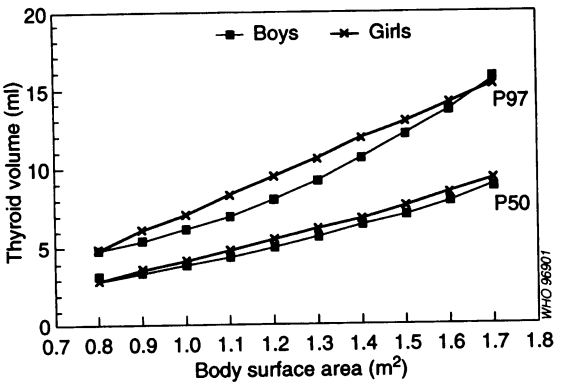


Fig. 2. **Changes in thyroid volume, by sex and body surface area, in iodine-replete children in Europe** (P50 = 50th percentile, i.e. median; P97 = 97th percentile, i.e. upper limit of normal). See ref. *3*.



Résumé

Valeurs normatives recommandées pour le volume de la thyroïde chez des enfants de 6 à 15 ans

L'inspection et la palpation sont les méthodes classiquement utilisées pour déterminer le volume de la thyroïde dans les régions où la carence en iode est modérée à sévère. Toutefois, dans les régions de faible endémicité, et d'une façon générale lorsque les goitres sont peu volumineux, l'échographie constitue une technique sûre et non invasive de détermination précise et objective du volume de la thyroïde. Elle doit être réalisée par des opérateurs bien entraînés disposant, pour une interprétation correcte, de critères de référence normalisés tirés de populations dont le bilan iodé est bon. Une enquête récemment effectuée chez des écoliers de 6 à 15 ans dans 12 pays d'Europe a fourni des données échographiques pour le calcul du volume de la thyroïde chez 7599 sujets, et des valeurs de l'iode urinaire chez 5709 sujets. Cet article indique les limites supérieures de la normale en fonction de l'âge lorsque le volume est déterminé par échographie chez des garçons et filles dont le bilan iodé est normal. Comme, dans les pays où la prévalence du retard de croissance est élevée, le volume de la thyroïde est provisoirement considéré comme étant plus directement fonction de la surface corporelle totale, l'article donne également les limites supérieures recommandées calculées par rapport à la surface corporelle. Ces deux séries de seuils sont recommandées pour l'interprétation des données d'enquête et de surveillance obtenues par échographie chez les enfants d'âge scolaire. On trouvera également dans cet article les modifications du volume de la thyroïde mesuré par échographie dans le sous-groupe d'enfants dont le bilan iodé est bon, d'une part en fonction de l'âge et du sexe, et d'autre part en fonction de l'âge et de la surface corporelle.

References

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