there was no difference between the four groups regarding these parameters.

We demonstrated that Group 1 was associated with poor fetal outcome for women labouring during the night and this may possibly reflect the poor quality of care during the period up to 0800 hrs, particularly in terms of decision-making but also in terms of inadequate fetal monitoring. A more active policy is usually adopted by the new staff taking over at 0700 hours. The 24-hour cover by neonatal staff might provide some beneficial effect during the night period. Some have shown the lowest mortality in units that offer facilities at night similar to those that are available during the day.

Explanations other than quality of care, such as biological variations or bias in data collection should also be considered. There could also be a selection bias in that better deliveries occur at a certain time rather than that better care during that period.

The present study is, thus, far too small to allow for any definite conclusions. The quality of care is one variable, however, which can be controlled by reorganisation of available services and further studies with larger number of cases will help to see if this is possible and practical.

REFERENCES


Severe iodine deficiency in two endemic goitre areas of Zimbabwe

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SUMMARY

The purpose of the study was to investigate the iodine status of the population and the possible role of goitrogens (that are metabolised to thiocyanate), in two endemic goitre areas of Zimbabwe. This was done through estimation of iodine (I) and thiocyanate (SCN) levels in spot urine samples collected from goitrous and non-goitrous subjects. Mean and median urine iodine concentrations respectively for Wedza (n = 50) were 1.4 μg/dl and 1.0 μg/dl and for Chiweshe (n = 60) were 2.1 μg/dl and 1.65 μg/dl. The differences between the two districts are significant (P = 0.005) and mirror the overall differences in goitre rates found. Urine I levels were generally lower in goitrous than non-goitrous subjects, but the difference was not significant. Mean urine SCN concentrations and mean I/SCN ratios respectively for Wedza were 0.5 μg/dl and 2.9 μg/dl and for Chiweshe were 0.7 μg/dl and 3.4 μg/dl. These results indicate that the populations studied are affected by severe iodine deficiency, but that thiocyanate does not have a significant goitrogenic effect. The implications of the results, and the reasons for the discrepancies between them and ones obtained in earlier studies, are discussed.

INTRODUCTION

In Zimbabwe, the presence of endemic goitre, as defined by thyroid enlargement affecting more than...
10 pc of the general population, or of school children aged six to 12 years, has been noted in many districts, especially in the north and east (and unpublished observations). It is now recognised that on a world-wide basis the principal cause of endemic goitre is iodine deficiency, although goitrogenic or iodine excess may also be responsible.

There has only been one published survey of the iodine status of the population in a known endemic goitre area of Zimbabwe. This study found median urinary iodine/creatinine ratios of between 50 and 75 \( \mu g/g \) in casual samples collected from 218 subjects in Chinamora Communal Land.

These results indicate mild iodine deficiency only, and are not consistent with the reported goitre rates, nor the prevalence of hypothyroidism found. A study of urine excretion in pregnant women at Harare Central Hospital found that iodine/creatinine ratios fell over a wide range, with 40 pc of results below 100 \( \mu g/g \). Harare Central Hospital draws patients from a large part of Zimbabwe and not just Harare city. The population studied is, therefore, heterogeneous, and it is hard to draw any firm conclusions from the results.

A possible role for goitrogens in the aetiology of endemic goitre in Zimbabwe was first postulated by Dent et al. They noted the high consumption of Brassicaceae, such as rape and cabbage, which contain the precursor of the potent goitrogen "goitrin". A dietary survey carried out by the Chinamora group indicated no role for goitrogens in the pathogenesis of goitres in the population studied. No biochemical estimations of goitrogens have been carried out in Zimbabwe.

Thiocyanate is the most common indicator of the consumption of goitrogenic foodstuffs. It is the principal metabolic derivative of the cyanogenic glucosides (principally found in cassava) and the thioglucosides (present mainly in Brassicaceae).

The aim of the current research was to study urine iodine and thiocyanate levels in two known areas of endemic goitre — Wedza and Chiweshe Communal Lands (personal observation).

**MATERIALS AND METHODS**

Spot urine samples were collected from goitrous and non-goitrous subjects residing in defined areas of Wedza and Chiweshe Communal Lands where endemic goitre was known to occur. 10ml aliquots of urine were chilled on collection, frozen within 18 hours and subsequently stored at -20°C.

Subjects for urine collection were randomly selected from four populations: those over 18 and those aged 12-15 years with and without goitre respectively. Those with a history of usage of iodised salt or other iodine supplements were excluded. All subjects encountered who were resident in the areas under study were graded for goitre. All thyroid examinations were performed by the same observer and goitres graded according to criteria currently recommended by the World Health Organisation.

Urine samples were transported on dry ice and on receipt were stored at -20°C until analysis. The urine iodine assay method used is based on the catalytic effect of iodine on the Sandell-Kolthoff reaction (the reduction of ceric ion by arsenious ion in acidic medium). The method was fully automated, utilising a Technicon Auto-analyzer (Technicon Instrument Corporation, Tarrytown, NY, USA) and incorporating automatic pre-digestion in strong acid. Thiocyanate was assayed by the method of Aldridge, modified by Michajlovskij and Langer. Statistical analysis of results was done using the Oxstat programme on an Amstrad personal computer. P values quoted are for the unpaired test. Since some data showed a skew distribution, significance was also tested by the Mann Witney U test and where P values are markedly different, values from both tests are given.

**RESULTS**

The goitre survey results are summarised in Table 1. Total goitre ratio (TGR) is the percentage of subjects examined with goitre (grades 1A, 1B, 2 and 3). Visible goitre rate (VGR) is the percentage of subjects examined with goitre that is clearly visible with the neck in the normal position (grades 2 and 3 only). The differences in total goitre rates between Wedza and Chiweshe are significant (P<0.05) except for males over 18 years.
The difference between thiocyanate results for Wedza and Chiweshe was significant (P<0.001). There was no significant overall difference in thiocyanate results between goitrous (x = 0.63 mg/dl (SD = 0.30)) and non-goitrous (x = 0.61 mg/dl (SD = 0.34)) subjects. The difference between urine iodine/thiocyanate ratio for Wedza and Chiweshe are not significant, nor are they significant between goitrous and non-goitrous subjects.

DISCUSSION

The urine iodine concentration results from this study indicate that the two districts are affected by severe and uniform iodine deficiency. At the general population level, the goitre rates found are inversely proportional to the urine iodine levels. The results are consistent with an average iodine intake of less than 50 μg/day in the areas studied.

Iodine intake should be at least 100–150 μg/day: less than 50 μg/day is insufficient for adequate thyroid hormone synthesis. Wedza is more severely affected than Chiweshe, since 78 pc of the sample population in Wedza, compared to 53 pc in Chiweshe, had urine iodine levels below 2 μg/dl.

Biochemical, if not clinical, hypothyroidism is a common finding in goitrous patients from these areas. No community level surveys of thyroid function have been carried out in these districts, but in Chinamora, a comparable area to Chiweshe (see below) 5 pc of subjects had Thyroid stimulating Hormone levels above 10 mu/l. Despite this high prevalence of hypothyroidism in the community, full blown cretinism is uncommon and personal observation. Lesser effects on brain development are to be expected, however, even in the absence of overt cretinism. The greatest significance of results lies not in the demonstration that endemic goitre in Zimbabwe is caused by iodine deficiency, but in the likely occurrence of a general depression of mental ability and work capacity in affected areas. The implications for Zimbabwe are enormous: perhaps two to three million people live in districts affected by a similar prevalence of goitre as Chiweshe or Wedza.

It is of interest that the differences in goitre found in the two age groups studied and between males and females, were not paralleled by differences in urine iodine levels. The differences in goitre rates are,
The urine iodine levels found in this study are generally much lower than those found by the Chinamora Research Team\(^3\) despite a similar prevalence of goitre in Chinamora (29 pc overall) and Chiweshe, and the close proximity of the two areas. Part of the reason for this disparity might lie in the use of iodine/creatinine ratios by the Chinamora researchers, as opposed to iodine concentration alone in this study. It is now recognised that the iodine/creatinine ratio may be unreliable for the assessment of iodine status of populations. Creatinine is meant to provide an index of urine concentration, obviating the need for 24-hour collections, but it has been demonstrated that creatinine concentrations show great variability and are generally lower in areas of low protein intake. This would have resulted in underestimation of the severity of the iodine deficiency.\(^7\)\(^1\)\(^1\) The use of iodine concentration alone provides much closer comparability to results obtained from 24-hour collections, provided a sufficient number of samples is collected.\(^1\)\(^1\) (24-hour collections are themselves difficult to collect under field conditions.)

It is now clear, however, that the main reason for the disparity between the Chinamora results and those found in this study was the method used to determine urine iodine. It has recently been demonstrated that automated urine iodine assay methods which utilise a dialysis step do not exclude substances other than iodide which may also catalyse the Sandell-Kolthoff reaction.\(^1\)\(^2\)\(^1\)\(^3\) These interfering substances include nitrites and ferrous ions, but the most important is thiocyanate. The levels of thiocyanate found in this study would result in an apparent urine iodine concentration of 2–3 µg/dl greater than the true concentrations, if the dialysis method were used, as it was in the Chinamora research. At low urine iodine concentrations, this could cause an over-estimation error or 100 pc or greater.

Despite their biochemical importance, the thiocyanate concentrations found in this study do not indicate a significant biological effect. A goitrogenic effect may occur at urine SCN concentrations of greater than 1,0 mg/dl; in severe endemic goitre areas complicated by creatinism urine I/SCN ratios of less than 2 are commonly found.\(^1\)\(^1\) Where urine thiocyanate levels are high, the main dietary source is usually inadequately detoxified cassava. Little cassava is consumed in Zimbabwe. It is salutary to note that in the Ubangi District of Zaire, where cassava is a staple food, creatinism is highly endemic and 15 pc of neonates have Thyroid stimulating Horme (TSH) values above 100 munit.\(^1\)\(^4\) Yet the mean urine iodine levels in Ubangi are around 2,1 µg/dl — higher than those found in Zimbabwe. The introduction of cassava into Zimbabwe, as has been proposed for some drier areas, without iodine supplementation, may have disastrous consequences. On the other hand, Zimbabwe may at the present time be spared the worst ravages of the Iodine Deficiency Disorders (IDD) because of the absence of any potent goitrogenic factors acting in conjunction with iodine deficiency.

Iodine deficiency occurs in Zimbabwe because of consumption of foods with low iodine content. This, in turn, reflects low iodine levels in the soil from which these foods are produced and lack of iodine supplementation. Iodine levels in soil build up over tens of thousands of years from rain water and are concentrated in the top few centimetres.\(^5\) Soil erosion leads to rapid loss of iodine. Severe endemic goitre in Zimbabwe generally occurs in those districts with higher rainfall and poor granite-based soils which have been severely eroded. Iodine deficiency in Zimbabwe is only likely to worsen unless an efficient national programme of iodine supplementation is instituted.

**CONCLUSION**

This study has demonstrated the association of severe iodine deficiency with a high prevalence of endemic goitre in two districts of Zimbabwe. Goitrogens that are metabolised to thiocyanate do not have a significant biological effect.

The results indicate that the populations in the districts studied have insufficient iodine intake to ensure adequate thyroid hormone synthesis and this accords with the observation of a high prevalence of hypothyroidism in affected areas. The most serious
effect is likely to be a general level of mental backwardness in affected communities.

Severe endemic goitre is widespread in Zimbabwe and possibly two million people or more are at risk of severe iodine deficiency. The urgent need for a national programme of iodine supplementation is underlined by these results.

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(Non Standard Abbreviations used: I = Iodine; SCN = Thiocyanate; IDD = Iodine Deficiency Disorders; TGR = Total Goitre Rate; and VGR = Visible Goitre Rate.)