Brief Report
Assessment of nutritional status in the Amazigh children of Amizmiz (Azgour Valley, High Atlas and Morocco)

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Summary
The Berbers of the High Atlas (Amazigh) live in very severe socio-economic and climatic conditions, which expose children to the risk of malnutrition. In this study we used anthropometry and bioelectrical impedance analysis for the assessment of nutritional status. Height, weight and bioelectrical parameters were taken on 71 children (28 boys and 43 girls). Height and BMI were standardized using the 2007 WHO reference. The results show that 36.6% of the children were classified as stunted and 8.5% as wasted. Based on the Bioelectrical Impedance Vector Analysis, children from the High Atlas had an adequate body cell mass, but a high risk of dehydration (42.3%).

Key words: anthropometry, bioimpedance, developing countries, malnutrition.

Introduction
The inhabitants of the Moroccan High Atlas are Berbers. Berbers, who call themselves Amazigh, have very ancient roots and have had a primary role in the peopling of north-western Africa. At present, they constitute around 40% of the Moroccan population [1]. The Berbers have always protected their cultural and linguistic independence from Arabic-speaking populations (their language belongs to the Afro-Asian linguistic family) [2], isolating themselves in inland territories and transmitting traditions orally.

The Azgour Valley is located on the northern side of the western High Atlas, at an altitude of 1500–2000 m. It is 70 km from Marrakech and can be reached by a path that is paved only in the part nearest the city. The valley’s population is ~4000 individuals, who live in eight villages. Agriculture is the main subsistence activity. The hygienic conditions are poor. There is no running water or electricity in the houses. Access to health services is limited.

The very severe socio-economic and climatic conditions pose risks of malnutrition. High rates of infant morbidity and mortality (103‰ in the first year of life) [3] might well reflect poor nutritional status in children. There are no studies on the nutritional status of the juvenile population of the High Atlas, only a recent study on adults [4].

The aim of this work—as a first step in a major program to assess the health status of the Amazigh population—is to evaluate the nature and extent of malnutrition in a juvenile sample from High Atlas villages, using anthropometry and bioelectrical vector analysis.

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Method

The study group consisted of 71 children (28 boys and 43 girls), aged 4–14 years. All girls were premenarcheal. The survey was conducted in connection with a local health programme and all the parents gave their informed consent to the study. Physical examination was performed by two physicians; anamnestic data, particularly the presence of gastrointestinal symptoms (nausea, vomiting, diarrhoea and abdominal pain) were collected. Anthropometric (height, cm; weight, kg) and bioelectrical (resistance, R, Ω; reactance, Xc; Ω) measurements were taken by an experienced observer following standard international criteria [5, 6].

Anthropometric analysis of nutritional status was performed using the growth standards from the 2007 WHO reference [7]. Height-for-age (HAZ) and BMI-for-age (BMIZ) z-scores were calculated using the LMS values. Stunting was defined as a low HAZ (z-score < –2 SD), according to the WHO criteria [8]. In agreement with Cole et al. [9], for the diagnosis of wasting, the −2 SD criterion was preferred to the 5th centile criterion suggested by the WHO expert committee [8].

Body composition was assessed by using bioelectrical parameters, following the procedure of Piccoli et al. [10]. The values of R/H, Xc/H were standardized using Italian bioelectrical reference values, the only data available in the literature [11]. Individual standardized Z vectors were plotted in tolerance ellipses (RXc score graph), in which the minor axis indicates cell mass (more mass on the left side) and the major axis refers to hydration status (dehydrated individuals towards the upper pole) [10]. Individuals were considered at risk of malnutrition when they fell outside the 75% ellipse to the right of the minor axis, and at risk of dehydration when their values fell outside the 75% ellipse towards the upper pole.

ANOVA and MANOVA were applied to assess the anthropometric and bioelectrical differences between children with and without gastrointestinal symptoms or diarrhoea.

Results

The descriptive statistics of the standardized values (HAZ, BMIZ) are shown in Table 1.

![Figure 1](image_url)

**FIG. 1.** Distribution of the standardized impedance vectors on the reference RXc-score graph, with 95%, 75% and 50% tolerance ellipses: 42.3% of the population is outside the 75% ellipse in the region of probable dehydration. Z (R), standardized resistance; Z (Xc), standardized reactance.

Discussion

The methods used in the present study provided different results. The anthropometric approach revealed a high prevalence of stunting (36.6%) and
a lower prevalence of wasting (8.5%). Bioelectrical analysis indicated a normal condition of body cell mass and a high prevalence of dehydration.

The divergence between anthropometric and bioelectrical approaches has been reported in other studies. High prevalence of stunting and, to a lesser degree, wasting, but a normal nutritional status (on the basis of the phase angle), were found in the rural Fulani of Nigeria [12] and in Amerindian Guahibos [13].

A pattern of higher prevalence of stunting than wasting is common in most developing countries, particularly in Latin America and in the Mediterranean region [14, 15]. This pattern could be attributed to causal dietary limiting factors with a specific effect on linear growth, such as a poor-quality diet (i.e. low amounts of animal foods and/or a low intake of micronutrients) [14–16]. Such causes may act even in the absence of energy malnutrition and wasting. Effectively, the diet of the Amazigh population is based mainly on cereals and vegetables (potatoes, tomatoes, carrots and onions). The intake of animal food and fruits is limited. Moreover, iodine deficiency disorders within the population, as suggested by a high frequency of goitre, indicate probable micronutrient deficiencies.

The high prevalence of dehydration could be related to environmental causes. The Azgour Valley is situated at 1500–2000 m. At this altitude, hypoxia, hyperventilation, extreme temperatures and high solar radiation cause fluid loss. Moreover, the population obtains water from a source located more than 1 km away; a critical value denoting high risk of dehydration [17].

In conclusion, the Amazigh juveniles appear characterized by a high prevalence of stunting and dehydration, with a poor prevalence of wasting and a normal condition of body cell mass. This pattern is likely caused by environmental factors (altitude) and by a low-quality diet. Further investigations are needed to define the diffusion of the phenomenon and the role of correlated factors.

References

18. Piccoli A, Pastori G. BIVA software. Padua, Italy: Department of Medical and Surgical Sciences, University of Padua, 2002.