Most Moroccan children now have enough iodine
Background
Morocco, a country in North Africa with a population of ca. 36 million, has legislated salt iodization as the national strategy against IDD [1]. In 1995, mandatory iodization of table salt at 80±10 mg of iodine/kg salt was introduced and subsequently adjusted in 2009 to 15–40 mg/kg [2]. Several previous studies in Morocco have assessed the iodine nutrition of children. In 1993, a national survey among school-aged children reported a median urinary iodine concentration (mUIC) of 86 µg/L and a mean goiter prevalence of 22%, but prevalence was highly variable, ranging from 0% to 77.4% in different regions [1]. Subsequently, smaller regional studies in Morocco have assessed the iodine nutrition of children. In 1993, a national survey among school-aged children reported a median urinary iodine concentration (mUIC) of 86 µg/L and a mean goiter prevalence of 22%, but prevalence was highly variable, ranging from 0% to 77.4% in different regions [1]. Subsequently, smaller regional studies in the mountains of Morocco reported that the prevalence of goiter among school-aged children was as high as 67% [3] and mUIC was <20 µg/L, indicating severe IDD [4]. A study of school-aged children in another rural mountainous area reported that the mUIC was 60 µg/L, suggesting mild ID [5].

It has been nearly 3 decades since the last national survey of iodine nutrition in Moroccan school-aged children [1], and, considering previous reports of severe IDD [3,4], updated data are urgently needed. Therefore, the aim of this study was to assess the current iodine nutrition in a nationally representative sample of 6–12-year-old school-aged children in Morocco by measuring the UIC in spot urine samples to inform the national salt iodization strategy.

Methods
This household-based survey was taken from March to June 2019. It was conducted at the national level in four geographic zones (North and East zone 1: coastal, mountainous; West zone 2: coastal, non-mountainous; Central zone 3: high altitude, non-coastal; South zone 4: coastal, mountainous, desert), covering the 12 regions of Morocco. A total of 180 clusters were selected using the probability proportionate to size sampling approach, as recommended by the WHO. Within each cluster, households were randomly selected.

In total, 3118 households were surveyed (60.4% in urban areas and 39.6% in rural areas). Within each selected household, a child aged 6–12 years was recruited for the survey if he/she was present in the household. A mid-stream spot urine sample was collected from the child. Urinary iodine was determined spectrophotometrically using the Sandell–Kolthoff method.
Results
1043 eligible children were recruited from the sampled households. In total, 56.3% were from urban areas and 43.7% were from rural areas; 50.5% were boys and 49.5% were girls. In total, 40.1% of children were from households belonging to the lowest socio-economic tercile and 27.8% were from the highest tercile.

The mUIC (95% CI) at the national level was 117 µg/L (110; 123). However, the percentage of surveyed samples with UIC < 50 µg/L was 21.6% (19.2%; 24.2%), which exceeds the WHO suggestion of no more than 20% of samples below 50 µg/L, despite an adequate mUIC in the total sample.

There were no statistically significant differences in mUIC by gender: the mUIC (95% CI) in boys and girls was 116 µg/L (107; 126) and 119 µg/L (102; 129), respectively. There were no statistically significant differences in mUIC by urban vs. rural areas: the mUIC (95% CI) in urban and rural clusters was 119 µg/L (110; 129) and 115 µg/L (102; 123), respectively. There were no significant differences in mUIC according to socio-economic status.

However, the mUIC was significantly lower in zone 3 (the high attitude non-coastal zone) compared to the other zones (p < 0.004). In the central (high attitude non-coastal) zone, children appeared to be mildly iodine deficient, with a mUIC (95% CI) of 89 (81; 103). These findings suggest that, despite iodine sufficiency at the national level, a small but significant proportion of children in Morocco may remain at risk for IDD.
Discussion

A national level mUIC value may conceal discrepancies in iodine intake among different sub-groups, including geographic region and/or socio-economic status (6). In Morocco, it appears iodine intake is comparable across rural and urban areas and across households with varying socio-economic status but not parental education. This equitable distribution of iodine intake suggests that the rural poor in Morocco are not at higher risk of ID, an important finding. However, the geographic zone analyses suggest that children residing in the central (high altitude non-coastal) zone are at higher risk of ID than those residing at lower non-coastal altitudes. This finding is in agreement with previous studies in other countries reporting an increase in the prevalence of ID with increasing altitude [7,8]. These data suggest that reaching children in high altitude non-coastal areas in Morocco with adequate iodine remains a challenge, such as communities in the Atlas Mountains in the south and/or the Rif mountains in the north. Based on our data, a future focus of the Moroccan iodized salt program should improve coverage of adequately iodized salt, particularly in these high-altitude non-coastal areas that do not have access to intrinsic sources of iodine, such as salt-water fish, seafood, and milk and dairy products from animals who consume iodine-rich feeds and fodder. Given the growing proportion of salt coming from processed foods in Morocco and the national policy to reduce salt consumption by 10% by 2025 (9), it may be important to extend mandatory salt iodization to include all salt used in the food industry. Strengthening the regulatory monitoring of iodization at the production sites to ensure adequate iodization of all table salt may also be valuable to ensure adequate iodine for all Moroccan children.

References