



# Poverty and immigration as a barrier to iodine intake and maternal adherence to iodine supplementation

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## Abstract

**Purpose** Iodine deficiency still remains a significant health issue worldwide. Pregnant and lactating women are at risk for iodine deficiency when living in mild iodine-deficient areas such as Italy. This study aims at evaluating the consumption of iodized salt, iodine-rich-foods and maternal micronutrient supplements in a group of women with limited access to the Italian National Health System.

**Methods** A cross-sectional survey was conducted among immigrant and Italian women living in poverty and referring to 40 Non-Governmental Organization throughout Italy for their health needs. 3483 women answered the ad hoc questionnaire between January 2017 and February 2018.

**Results** The consumption of iodized salt was very low, and even lower among immigrant women. Determinants of iodized salt consumption were the period spent in Italy for immigrant women and living in a family-type setting, parity and, particularly, the degree of education for Italian ones. 17.5% of immigrant women and 8.6% of the Italian ones reported a diagnosis of thyroid disease. 521 women, 75.4% of whom were immigrants, were pregnant or breast-feeding. The majority (57.3%) had no specific maternal supplementation.

**Conclusions** Both Italian and immigrating women with a low income or without access to the public health system have a poor adherence both to the salt iodization policy and to folic acid and iodine supplements in preconception and pregnancy. They also referred a low-frequency intake of iodine-rich-foods. The identification of barriers to health care access could be useful to promote specific health interventions in this target population.

**Keywords** Iodine intake · Iodine supplementation · Thyroid diseases · Woman health

## Introduction

Iodine is essential for thyroid hormone synthesis. Iodine deficiency has many adverse effects at all stages of life [1] but mainly in the fetus and the neonate when normal neurodevelopment can be jeopardized [2]. Maternal iodine deficiency may cause adverse pregnancy outcomes (stillbirths, congenital anomalies, fetal goiter), increased perinatal and

infant mortality and impaired mental function ranging from subtle loss of intelligence quotient (mainly verbal abilities, reading accuracy and comprehension) [3] to cretinism [4]. These neurocognitive defects are not reversible or ameliorable even if children born to iodine-deficient mother attain iodine sufficiency during infancy [5]. In adult life, the consequences of inadequate iodine intake may lead to the development of nodular goiter or iodine-induced thyroid dysfunction [6].

Iodine supply comes almost exclusively from diet. The native iodine content of most foods and beverages is low, and most commonly consumed foods provide 3–80 µg per serving. During the last decades, many efforts have been done to reach iodine sufficiency through iodine fortification of foods, especially of salt. Major dietary sources of iodine in the USA and Europe are household iodized salt, bread and milk [1, 7–9]. Boiling, baking, and canning of foods,

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which contain iodized salt, cause only small losses ( $\leq 10\%$ ) in the iodine content [10]. However, many people eat processed foods and, often, industries do not use iodized salt in preparation [11].

Worldwide, iodine deficiency still remains a significant health problem affecting, unexpectedly, also developed countries [12]. Based on reports from 2017 Iodine Global Network, in many European countries, including Italy, Denmark, Finland, UK, Ireland, the intake of iodine does not reach the WHO recommended dose of 150  $\mu\text{g}$  for men and non-pregnant non-lactating women [12]. The awareness of iodine sufficiency as an important issue for health is still low in the general population. Indeed, data from the United States indicate that only 14.8% of women in their reproductive age use iodine-containing dietary supplements. Seventy-two percentage of pregnant women do take any dietary supplement, but only 17.8% of them use an iodine-containing one [13]. Thus, many of these women fail to reach the recommended daily iodine allowance for pregnant and lactating women (250  $\mu\text{g}$ ). Overall, women in their reproductive age, particularly when pregnant, are considered at risk for iodine deficiency when living in mild iodine-deficient areas such as Italy [7], because they enter pregnancy with already depleted iodine stores [6].

The awareness about iodine as an essential nutrient is of crucial importance for adherence to iodine prophylaxis programs and related dietary recommendations. This knowledge may be particularly limited in women with a poor socioeconomic status or with linguistic or cultural barriers, which eventually impair their access to the health care system. In Western societies, it has been demonstrated that immigration from foreign underdeveloped countries may influence the access to health programs [14, 15]. For example, in a recent study from Italy, Bini et al. analyzed drug dispensation by charitable organizations to people not covered by the National Health Service. They concluded that these people, both Italians and immigrants, have a different disease distribution and different therapeutic needs compared to Italians and immigrants accessing to National Health Service [16]. To further aggravate the problem in Italy, immigrant women from Africa, Latin America and East Europe show a higher fertility rate when compared with Italian women [17] and in Northern Italy, they account for 28% of all pregnancies [18]. In many cases, their adherence to health care and micronutrient fortification programs is limited. This is particularly troublesome for immigrant women coming from countries of severe iodine deficiency, as recently reported for Morocco. Paradoxically, immigrant women coming from countries of sufficient iodine intake are also at risk, because the new environment could significantly change their dietary habits [19].

Aim of this survey was to investigate in a large group of Italian and immigrant women, living in poverty or not

enrolled in the Italian National Health Service, the prevalence of self-reported thyroid diseases, the dietary intake of iodine-rich foods, the household consumption of iodized salt and the possible determinants of adherence to iodine prophylaxis programs.

## Subjects and methods

This survey included immigrant women not enrolled in the Italian National Health Service and/or Italian women living in poverty and usually not attending the national health facilities. Included women were older than 16 years and presented from January 2017 to February 2018 to 40 Non-Governmental Organizations (NGO) which care for people or living in poverty. Twelve NGOs involved in the survey were located in Northern Italy, 12 in Central Italy and 16 in Southern Italy. These NGOs dispense drugs provided by the “Banco Farmaceutico”, another Italian NGO, which has over 1500 centers distributed throughout the nation.

We developed an ad hoc questionnaire focused on:

1. Personal data: age, ethnicity, level of education, marital status, parity, period spent in Italy (only for foreign women);
2. Family or personal history regarding: (a) thyroid diseases and chronic diseases; (b) present use of thyroid-specific drugs (i.e. Levo-thyroxine for hypothyroidism and methimazole or propylthiouracil for hyperthyroidism);
3. Present or previous use of folic acid or maternal multiple micronutrient supplementation during pregnancy;
4. Household consumption of iodized salt;
5. Weekly intake of iodine-containing foods (milk, cheese, yoghurt, egg, and fish).

The questionnaire consisted of 14 items taking 5–10 min to be completed.

All subjects gave their informed consent to participate in the study, which was performed in accordance with the guidelines of the Declaration of Helsinki.

During a period of 14 months, 3483 women completed the questionnaire.

## Statistical analysis

Results are given as frequencies, mean  $\pm$  SD or as median and interquartile range, as appropriate. Chi-squared test was used to compare categorical data, using Fisher's correction when appropriate. The multivariate logistic regression model was constructed by entering household consumption of iodized salt as dependent variable, while age, parity, marital status, education, and period spent in Italy (only

for foreign women) were entered as covariates. A  $p$  value  $< 0.05$  was considered significant. Statistical analysis was performed using the SPSS software (SPSS, Inc., Evanston, IL, USA).

## Results

The study group included 1478 Italian women (42.4% of the total) and 2005 immigrant women (57.6% of the total). In the latter group, only a few women came from countries in the European Community (0.5%), while the majority came from countries in Eastern Europe (53.6%), from Africa (30.2%), from Asia (11.6%) and from Latin America (4.1%).

Table 1 summarizes personal data in the whole group, and in the Italian and immigrant subgroups.

The prevalence of women in their reproductive age, considered as a class age less than 40 years, was significantly higher in the immigrant women group (66.9%) when compared to the Italian women group (56.4%,  $p = 0.000$ ). Foreign women were also more frequently married or cohabitant (49.3% and 14.3% vs 39.6% and 9.6% of Italian women, respectively,  $p = 0.0000$ ), had a higher birth rate (no pregnancy 35.5% vs 46.8%,  $p = 0.0000$ ) and a lower educational level (high school or university degree in the 22.9% of immigrant women and 54.2% in Italian women,  $p = 0.000$ ).

A diagnosis of chronic disease was reported by 14.7 and 18.7% of Italian and immigrant women, respectively. Chronic diseases were mainly represented by hypertension (64% of all chronic diseases in the whole group) and diabetes mellitus (35%) with no difference between the two groups. Renal disease was reported by 13% of women and the prevalence in immigrant women was significantly higher than in Italian women (16.7 vs 6.8,  $p = 0.002$ ). When specifically enquired, 17.5% of immigrant women reported a diagnosis of thyroid disease, which was on active treatment in the great majority of them (81.5%). The correspondent figure in Italian women was significantly lower (8.6%,  $p = 0.0001$ ). The diagnosis of thyroid disease was self-reported by the women included in the study and was not validated or further characterized by an endocrinologist. However, by the analysis of drug dispensation by charitable organizations, it was evident that treatments with levothyroxine were similar in the two groups, while treatments with antithyroid drugs were significantly more frequent in immigrant women (21.5 vs 11.2%, respectively,  $p = 0.04$ ). Immigrant women reporting levo-thyroxine therapy were more frequently represented by the classes of age 31–39, 40–49 and 50–59 years, when compared to Italian women (20.8, 26.5 and 23.4% vs 6.3, 7.36 and 12.6%,  $p = 0.001$ ,  $p = 0.0001$  and  $p = 0.0247$ , respectively). On the contrary, no significant differences were found for antithyroid drug therapy when analyzed according age distribution.

**Table 1** Personal data (age, marital status, parity, level of education, period spent in Italy, and weight changes) in the whole group, in Italian and in immigrant women

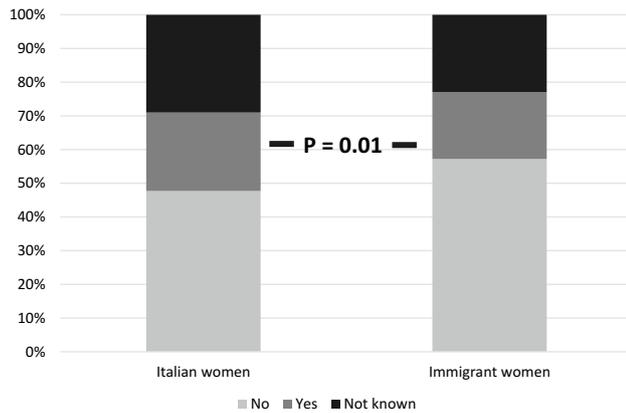
	Whole group $n = 3483$ (%)	Italian women $N = 1478$ (%)	Immigrant women $n = 2005$ (%)	
<b>Age distribution</b>				
< 18	9.2	19.4	1.6	<b>0.0000</b>
18–25	14.2	9.3	17.9	<b>0.0000</b>
26–30	15.9	11.6	19.1	<b>0.0000</b>
31–39	23.1	16.0	28.3	<b>0.0000</b>
40–49	17.4	15.8	18.6	<b>0.0331</b>
50–59	11.4	14.0	9.5	<b>0.0000</b>
> 60	8.7	13.8	5.0	<b>0.0000</b>
<b>Marital status</b>				
Single	42.5	50.8	36.5	<b>0.0000</b>
Cohabitant	12.3	9.6	14.3	<b>0.0000</b>
Married	45.2	39.6	49.3	<b>0.0000</b>
<b>Parity distribution</b>				
No pregnancy	40.2	46.8	35.5	<b>0.0000</b>
1 pregnancy	20.2	19.9	20.4	0.7399
2 pregnancies	23.5	20.1	25.9	<b>0.0001</b>
3 pregnancies	11.2	9.9	11.9	0.0719
≥ 4 pregnancies	4.9	3.3	6.3	<b>0.0000</b>
<b>Degree of education</b>				
None	7.3	5.9	9.4	<b>0.0002</b>
Elementary	20.2	14.1	24.5	<b>0.0000</b>
Junior high school	35.8	25.8	43.1	<b>0.0000</b>
High school	28.4	41.2	18.4	<b>0.0000</b>
University	8.3	13.0	4.5	<b>0.0000</b>

Statistically significant differences are shown in bold

Figure 1 shows the household consumption of iodized salt. In the whole group of women, the consumption of iodized salt was very low, and particularly in immigrant women compared with the Italian ones (19.9% vs 23.3%, respectively,  $p = 0.01$ ).

Figure 2 summarizes the results of food questionnaire evaluating the intake of iodine-containing foods, and in particular the percentage of women who never or rarely ate iodine-containing foods.

The percentage of immigrant women who never consumed foods with high iodine content was always significantly higher when compared with their Italian counterparts. In detail, the prevalence of immigrant women who never consumed milk, cheese, yogurt, eggs or fish was 30, 38, 43, 26, and 33%, respectively. These prevalences



**Fig. 1** Household consumption of iodized salt in Italian and immigrant women

were always statistically significant ( $p = 0.0001$  for milk, cheese and fish,  $p = 0.0013$  for egg) when compared with Italian data from Italian women. Even a limited (1–3 times per week) consumption of iodine-rich foods was more frequently reported by Italians, compared with immigrant women. Regarding dairy products, near one half of immigrant women had an intake lower than three times per week.

Since it is generally accepted that the use of iodized salt is a crucial determinant of the iodine status, a multiple regression analysis was performed taking into account age distribution, parity, marital status, education, and period spent in Italy (only for foreign women) as covariates of household consumption of iodized salt. In Italian women, the main determinants of iodide salt consumption were living in a family-type setting (married or cohabitant), parity and, particularly, the degree of education. In the immigrant

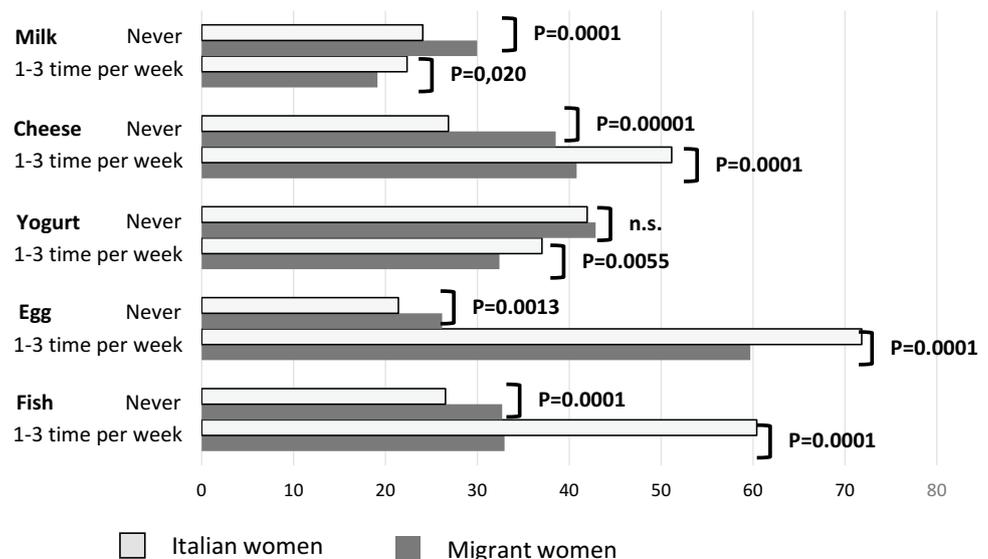
group, iodized salt consumption was significantly related only to the period spent in Italy (Table 2).

Among the 3483 women included in the survey, 521 (15%) women were pregnant or breast-feeding when interviewed. The prevalence of immigrant women within this group was 75.4%. When compared to not pregnant women matched for age distribution, their personal data, the frequency of iodized salt use and the intake of iodine-containing foods were similar.

Pregnant women were more frequently aware to be affected by a thyroid disease when compared with not pregnant women (17.0% vs 11.5%, respectively,  $p = 0.0006$ ), but the prevalence of thyroid diseases on active treatment was similar in the two groups. Immigrant pregnant or breast-feeding women were more frequently represented in the class of age 18–25 years (33.1% vs 18.7%, respectively,  $p = 0.0022$ ) and had a lower educational level (high school or university degree in the 17.9% of immigrant women and 56.1% in Italian women,  $p = 0.000$ ).

In the whole group of pregnant women, when specifically enquired, only 22% of women reported using maternal multiple micronutrient supplements containing variable amounts of iodine; 19.1% of them used folic acid supplementation only. The majority (57.3%) had no specific maternal supplementation. Figure 3 shows the household consumption of iodized salt and the use of specific maternal supplementation in pregnant or breast-feeding Italian and immigrant women. Immigrant pregnant women reported a household consumption of iodized salt in a higher percentage when compared to Italian women (23.7% vs 9.7%, respectively,  $p = 0.008$ ). However, the frequency of immigrant women without any maternal multiple micronutrient supplementation during pregnancy was significantly higher than the frequency reported in

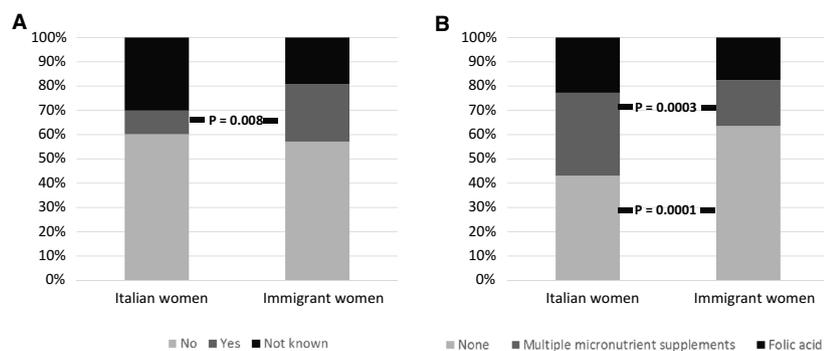
**Fig. 2** Weekly intake of iodine-containing foods in Italian and immigrant women (%)



**Table 2** Household iodized salt consumption according to age distribution, marital status, parity, education and period spent in Italy (only for foreign women), in Italian (a) and immigrant (b) women (multiple logistic regression summary)

(a)						
Italian women	Beta	Standard error of beta	<i>B</i>	Standard error of <i>B</i>	<i>t</i> (1449)	<i>p</i> level
Age distribution	-0.039442	0.036543	-0.002156	0.001997	-1.07934	0.280617
Marital status	-0.084035	0.032923	-0.076079	0.029806	-2.55243	<b>0.010799</b>
Parity	0.098420	0.037380	0.072517	0.027542	2.63297	<b>0.008554</b>
Education	0.332525	0.026483	0.266819	0.021250	12.55617	<b>0.000000</b>
(b)						
Immigrant women	Beta	Standard error of beta	<i>B</i>	Standard error of <i>B</i>	<i>t</i> (1961)	<i>p</i> level
Age distribution	-0.041118	0.027316	-0.002884	0.001916	-1.50525	0.132422
Marital status	-0.041219	0.027628	-0.036559	0.024505	-1.49191	0.135882
Parity	0.025310	0.029964	0.016582	0.019632	0.84468	0.398391
Education	0.040940	0.022870	0.033986	0.018985	1.79012	0.073589
Period spent in Italy	0.073160	0.025209	0.042097	0.014506	2.90213	<b>0.003748</b>

Statistically significant determinants are shown in bold

**Fig. 3** Household consumption of iodized salt (a) and use of specific maternal supplementation (b) in pregnant or breast-feeding Italian and immigrant women

Italian women (57.1% vs 34.1%, respectively,  $p = 0.0003$ ). The results of food questionnaire evaluating the intake of iodine-containing foods were similar in pregnant or breast-feeding Italian and immigrant women, and confirmed the trend observed in the whole group.

In the multiple regression model, the main determinants for the use of household iodized salt and of maternal multiple micronutrient supplementation in the whole group of pregnant women were to live in a family-type setting and the period spent in Italy ( $p = 0.0066$  and  $p = 0.0254$ , respectively). When the same analysis was performed in Italian women, the only significant determinant for the use of household iodized salt and of maternal multiple micronutrient supplementation was the degree of education ( $p = 0.0050$ ). In immigrant women, the multiple regression model showed that the use of household iodized salt and of maternal multiple micronutrient supplements were significantly associated with the period spent in Italy (0.0199).

## Discussion

Aim of the present study was to explore the consumption of iodine-rich foods and the use of iodized salt and/or maternal multiple micronutrient supplements containing iodine in a large group of women for whom poverty and/or linguistic or cultural barriers limit the access to the health programs provided by the Italian National Health System. To the best of our knowledge, there are no previous data focusing on iodine status among Italian and immigrant women of child-bearing age cared by Non-Governmental Organizations. The main finding of this research is that these women had a poor adherence both to iodized salt prophylaxis and to recommendations regarding folic acid and iodine supplements in preconception and pregnancy. The strongest determinant of this phenomenon was the level of education for Italian women and the time spent in Italy for immigrant women.

Italy is a mild to moderate iodine-deficient country, where pregnant women are at risk for Iodine deficiency [6, 20, 21]. Since 2005, a nationwide program of iodine prophylaxis on voluntary basis was implemented in Italy to correct iodine deficiency. However, a recent Italian observational study demonstrated that even in areas of adequate iodine intake, most pregnant women appear to be not fully protected against iodine deficiency [22]. Iodine nutritional status in Italian pregnant women was also evaluated between 2007 and 2012 in 2456 healthy pregnant women not using iodine-containing supplements. Their urinary iodine concentrations, ranging from 62 to 95  $\mu\text{g/L}$ , were well below the range established by WHO/UNICEF/ICCIDD as indicative of iodine sufficiency in pregnancy (150–249  $\mu\text{g/L}$ ) [12, 21, 23]. These and similar findings in other European countries prompted the experts to warn against the risk of mild to moderate iodine deficiency among pregnant women, because of possible negative repercussions on children cognitive outcome [23, 24].

Despite growing concern about the prevalence of iodine deficiency among women of childbearing age in Europe, a recent study demonstrated a worrisome lack of knowledge about dietary sources of Iodine, as well as problems arising from Iodine deficiency among women of childbearing age living in UK and Ireland [25]. Since the level of awareness about iodine is of crucial importance for adherence to iodine prophylaxis programs and related dietary recommendations, in this study we evaluated iodine consumption and supplementation in a particularly vulnerable group of women, namely in Italian and migrant women with a low socioeconomic status or with linguistic or cultural barriers, limiting their access to the health care system. Several factors limit their access to health care system in these women, namely poverty, shame for their own condition, lack of knowledge about health facilities or fear to be identified. The 2016 report published by Banco Farmaceutico showed an increase in poverty among Italian families (+0.4% vs 2015). Similarly, there was an increase in the number of people not covered by National Health System and assisted by NGO (+37.4%) [26]. Describing the health status of such a population is difficult, especially in the case of irregular immigrants who are now a growing population in western Countries and for which a linguistic barrier also exists. Data regarding children in these families are almost inexistent.

In a previous retrospective survey, we analyzed self-reported iodized salt consumption in a population of women coming from Latin American countries and living in Northern Italy. In this population, although all participants were regular immigrants with a fair integration and high school education level, we found a low consumption of high iodine-containing foods and a low degree of information about iodine importance [19]. In line with our findings, iodine deficiency is considered as a public health concern in some

immigrant populations, as recently described by Madar et al. [27], in a Somali immigrant group living in Oslo.

In the present study, immigrant women were mainly in their childbearing age. A public health perspective showed that immigrant women have a higher fertility rate than the native ones (1.95 and 1.27 child for woman, respectively) [18, 28, 29] and this trend was confirmed in our survey.

The prevalence of self-reported diagnosis of thyroid diseases was significantly higher in immigrant women compared with the Italian ones. In both groups, hypothyroidism and the related L-thyroxine replacement therapy was the most prevalent condition. However, immigrant women more frequently were treated with antithyroid drugs for hyperthyroidism. To explain this observation, several hypotheses can be formulated. First, immigrant women coming from Africa (30.2%) and Eastern Europe (53.6%) probably have a multinodular goiter resulting from a life-long exposure to moderate or even severe iodine deficiency [30]. Because in their natural history these goiters can develop functional autonomy and eventually hyperthyroidism [31] and the need for antithyroid drug treatment would be easily explained. Second, stress-related Graves' disease, commonly known as Krieger–Basedow, could be responsible for hyperthyroidism in immigrant women coming from war zones and/or having experienced life-threatening journeys to reach Italy.

While the socioeconomic condition was similarly low, our study revealed that Italian women had a significantly higher educational level compared with the immigrant ones. The household consumption of iodized salt was very low in both groups, but particularly in the immigrant women group (users = 19.9%). Data regarding iodized salt sales in Italy showed that nearly 55% of Italian people commonly use iodized salt [21]. The low prevalence of women using iodized salt in the present study highlights the need to improve education and communication strategies to avoid the detrimental effects of iodine deficiency. The main determinants of iodine consumption were different in the two groups of women. In Italian women, the household use of iodized salt was significantly associated with a family life setting and with a higher degree of education. In immigrant women, the time spent in Italy was the only determinant of iodized salt use. These findings suggest that immigrant women may be at increased risk of iodine deficiency due to lack of knowledge about programs of iodine prophylaxis. Thus, communication aimed at improving health should be tailored on the target population, focusing the attention on previous notion or on new information, as appropriate. Compared with Italian women, the immigrant ones also reported a lower consumption of iodine-rich foods. In particular, dairy products, the most important source of iodine after iodized salt, were consumed less than three times per week by 50% of immigrant women. Although the iodine content of food is difficult to estimate, due to its dependence

on the iodine content of soil, farming practices and season, probably, in most immigrant women and in a consistent percentage of Italian women living in poverty, the daily iodine intake was much lower than that recommended for non-pregnant, non-lactating women (150 µg/die) [32].

In both subgroups of pregnant women, the use of maternal multiple micronutrient supplements containing iodine was very low. Once again, the main determinants of the use of maternal supplementations were the degree of education and the time spent in Italy for Italian and immigrant women, respectively. Several previous studies demonstrated that immigrant women are at higher risk than native women for experiencing a worse pregnancy outcome, as shown by a higher incidence of prematurity, low birth weight, asphyxia, neonatal mortality and unplanned cesarean sections [32–34]. Their progeny is also at risk of developing neonatal goiter and mental retardation [5, 35]. From a public health perspective, the fact that immigrant women have a higher fertility rate than the native ones [1, 7, 12] is particularly worrisome due their increased risk of iodine deficiency.

The lack of direct measurement of urinary iodine concentration (UIC), which is considered the gold standard to assess iodine status is the main limitation of the present study. However, some previous studies found variable degrees of correlation between UIC and the food frequency questionnaires. Mian et al. and Rasmussen et al., demonstrated a good correlation between reported milk consumption and UIC [32, 36] I, while Leung et al. [37] did not find a strong association between dietary-reported iodine intake and UIC. Globally, the food frequency questionnaire could represent a preliminary step for the assessment of iodine adequacy.

In conclusion, to the best of our knowledge, this is the first survey focusing on iodine status among women living in poverty and/or migrating to Italy. The main findings of this research is that among this wide group of women, there is a poor adherence both to the salt iodization policy and to recommendations regarding folic acid and iodine supplements in preconception and pregnancy, further worsened by a low-frequency intake of foods with high iodine content. This may result from a low income or from difficulties in accessing the public health system. The identification of barriers to health care access, namely education and knowledge, could be useful to promote interventions through large-scale advertising, informative materials easy to understand and iodine and folic supplementations not only to pregnant or lactating immigrant women, but also to those planning a pregnancy.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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