International Journal of Cardiology Cardiovascular Risk and Prevention 11 (2021) 200112

Contents lists available at ScienceDirect

International Journal of Cardiology Cardiovascular Risk and Prevention

journal homepage: www.journals.elsevier.com/international-journal-of-cardiology-cardiovascular-risk-and-prevention

Research Paper

Gender differences in acculturation and cardiovascular disease risk-factor changes among Chinese immigrants in Italy: Evidence from a large population-based cohort

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ARTICLE INFO

Keywords:
Hypertension
Type 2 diabetes
Overweight or obesity
Cardiovascular prevention
Ethnicity
Health policies
Immigration
Migrant

ABSTRACT

Background: In recent decades, the Chinese presence in Southern Europe has grown rapidly but no data is available on the influence that residing in Mediterranean countries has on Chinese immigrants. In this study, we aim to examine the association between acculturation and cardiovascular risk factors among first-generation Chinese immigrants in Italy.

Design: Population-based, cross-sectional study.

Methods: A sample of 2589 Chinese first-generation immigrants (1599 women and 990 men) living in Prato, Italy, underwent blood pressure measurement, blood tests (with measurement of glucose, cholesterol, and triglycerides), and anthropometric measurements. The influence of length of residence (dependent variable) on hypertension, type 2 diabetes, overweight/obesity, and hyperlipidemia (high cholesterol) (independent variables) was investigated with multivariable logistic regression adjusted for age, sex, education and urban/rural home area in China before migration.

Results: Mean age of Chinese participants was 47.2 ± 10.7 years and 61.7% were women. Immigrants residing in Italy for ≥20 years were more likely to be hypertensive [odd ratio (OR) 1.84; 95% confidence interval (CI) 1.33 to 2.59], or diabetic (1.91; 1.26 to 2.86) than those residing in Italy for <10 years. Differently, prevalence of hypercholesterolemia (total cholesterol≥240 mg/dl) was lower in immigrants residing in Italy for ≥20 years than in those with <10 years of residence (0.52; 0.32 to 0.83). The association between indicators of acculturation and cardiovascular risk factors appeared to differ by sex.

Conclusion: Acculturation of Chinese immigrants in Italy was associated with hypertension and type 2 diabetes whereas a favorable effect on hypercholesterolemia was observed.

1. Introduction

Migration to affluent countries entails environmental, nutritional and lifestyle changes [1,2] often associated with a less favorable social position than the country of origin. This can lead to a shift towards less healthy behavior with a negative effect on the cardiovascular risk profile [3,4]. Knowledge of the peculiarities of the acculturation process of different ethnic groups is a key element for the definition of specific health promotion policies and interventions for ethnic minorities [5–7].

In recent decades, the Chinese presence in Southern Europe has grown rapidly but no data is available on the acculturation of the Chinese in this area. In fact, the data are limited to countries such as the United States [8], Canada [9], and Australia [10]. In the United States, Chinese immigrants adopted poor eating habits and inactive lifestyles [8]; long-term residence in Canada was associated with a higher prevalence of cardiovascular risk factors [9]; migration to Australia was associated with an increased prevalence of metabolic diseases [10]. The first consideration is that these countries are characterized by different habits and lifestyles from those of the Mediterranean area. Second, all the studies conducted on the Chinese population [8–10] were based on

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https://doi.org/10.1016/j.ijcrp.2021.200112
Received 16 September 2021; Received in revised form 11 October 2021; Accepted 19 October 2021
Available online 23 October 2021

self-reported data and therefore may be prone to misclassification or differential reporting. Third, no clear information was given regarding possible gender differences in the effects of acculturation of the Chinese population.

The present study was therefore designed to examine the association between residence time in Italy and major cardiovascular disease (CVD) risk factors in a first-generation Chinese immigrant community.

2. Methods

2.1. Setting, and study population

The CHinese In Prato (CHIP) is a participatory research project designed to investigate the health needs of the Chinese community resident in Prato [11]. Located in Tuscany, 30 km from Florence, Prato has a population of approximately 200,000 inhabitants with the highest proportion of Chinese immigrants of any Italian province [12–14]. A community–academic partnership composed of the Consulate General of Florence, local community-based Chinese organizations, and the Chinese and Italian Universities, was created to lead the CHIP (CHinese In Prato) project [12–14]. In the CHIP project the Chinese population was enrolled in a cardiovascular, risk-factor, screening program through a sensitive, culturally appropriate, non-coercive recruitment and an enrolment process that adopted a network sampling procedure as previously described [15]. Each participant received the results of all clinical and biochemical tests undergone, with a clear statement of whether the diagnostic criteria for hypertension, type 2 diabetes, or dyslipidemia were met or not. Participants with screen-detected diseases then received assigned treatment through the Regional Health System, based on current recommendations. Baseline data were collected between July 2014 and November 2019. The study was approved by the "Comitato Etico Regione Toscana, Sezione Area Vasta Centro" ("The Ethics Committee of the Region of Tuscany, Section of the Vast Central Zone") (Rif. OSS 14.089). All participants provided written informed consent to participate in this study.

2.2. Data collection and diagnostic criteria

Fasting participants attended a health screening where anthropometric and blood pressure measurements were taken, blood samples collected, and a questionnaire was issued.

Anthropometric measurements were taken as previously reported [12–14]. Body mass index (BMI) was stratified according to the Chinese definitions (underweight: BMI<18.0 kg/m^2; normal: BMI 18.0–23.9 kg/m^2; overweight: BMI 24.0–27.9 kg/m^2; obesity: BMI≥28.0 kg/m^2) [16]. Chinese cut-offs for large waist circumference were also used: >80 cm (females) or >85 cm (males) [16].

Blood pressure (BP) was measured 3 times according to current guidelines [17] using a clinically validated semiautomatic digital sphygmomanometer (M6; Omron Matsusaka Co. Ltd., Japan) [15]. The average of the last two readings was used for analysis. Hypertension was diagnosed if systolic BP (SBP) was ≥140 mmHg, or diastolic BP (DBP) was ≥90 mmHg at 2 visits, or if anti-hypertension medication had been taken in the previous 2 weeks. Blood pressure was diagnosed and stratified according to the recommendations of the 2018 European Society of Hypertension (ESH) – European Society of Cardiology (ESC) guidelines (grades ESH-ESC) [17].

Blood samples were immediately processed with validated Point of Care (POC) diagnostics as previously reported [12–14]. Diagnosis of type 2 diabetes was based on fasting plasma glucose criteria (≥126 mg/dL confirmed by repeated testing at a second visit) and/or current treatment with glucose-lowering drugs. Type 1 diabetes was defined by clinical parameters, including absolute need for insulin, young age of onset, and history of ketosis, for the purpose of this study. High cholesterol was classified for total cholesterol (TC) levels ≥240 mg/dL [17], and high triglycerides (TG) was classified for TG ≥ 200 mg/dL [17].

The areas investigated by the questionnaire were education level (no studies, primary and secondary school, high school, college or more), alcohol use, smoking (current smokers, and noncurrent smokers defined as those who had never smoked and former smokers who-had stopped smoking), health insurance (none; STP card, Foreigner Temporary Present; full registration to the Regional Health Service), Italian speaking (yes or no), and migration history (years of residence in Italy, area of origin in China). Adherence to the Mediterranean dietary pattern was also assessed using the Mediterranean Diet Score assessment questionnaire [18]. The resulting index of adherence ranged between 0 and 55 points. When higher than 30 points, the score was considered sufficient.

2.3. Outcomes

A first-generation Chinese immigrant was defined as a person born in China with both parents also born in China. Using 10 years of residence in Italy as a cut-off for low acculturation [19], the adult study population was stratified into three groups (<10 years of residence in Italy; 10–19 years; 20–30 years). Overweight/obesity, hypertension, diabetes mellitus, and hyperlipidemia (high cholesterol), were the four main outcomes. CVD risk factors were operationalized both as a single risk factor and an overall CVD risk-index score (e.g. having more than 2 risk factors).

2.4. Statistical analysis

For descriptive statistics, means and standard deviations or percentages are given for each sample. Variables were analyzed first using chi-squared tests for categorical variables or t-tests for continuous variables.

For each of the four main outcomes, we fitted a multiple logistic regression model with length of residence in Italy as the main predictor (reference group <10 years) controlling for age, sex, region of birth, and education. In addition to these covariates, BMI was included as a covariate in the model with diabetes mellitus, hypertension and hyperlipidemia as the outcomes. These covariates were included because of their clinical importance, our bivariate findings and previous studies, which have shown that these variables confound the relationship between acculturation and CVD risk factors. IBM SPSS software (version 27.0, SPSS Inc., Chicago, Illinois, USA) was used for analysis.

3. Results

3.1. General characteristics of the study population

Overall, 2589 participants in the CHIP study (1599 women and 990 men), born in the provinces of Zhejiang (80%), Fujian (12%), or Liaoning (5.2%) were included in the analysis. Only 24% had lived in Chinese urban areas, the vast majority (82%) were from rural China. Participants were mainly employed doing light manual work in the textile industry (unskilled workers, 1154 women and 793 men), only a minority being retired (63 women and 80 men), or managers/white collar (141 women and 84 men). The basic sociodemographic characteristics of the study participants stratified by length of residence in Italy are presented in Table 1.

3.2. Cardiovascular risk factors and length of residence in Italy

When the studied population was stratified according to the time of residence in Italy, differences in hypertension and diabetes were evident (Table 1). Of course, the 3 groups of participants differed in age (Table 1) and adjusted logistic regression analysis was thus performed. In the overall Chinese population, the prevalence of hypertension and type 2 diabetes increased whereas hypercholesterolemia was found to decrease with the length of residence in Italy (Table 2). No association

Table 1
Sociodemographic and clinical characteristics of the study participants stratified by length of residence in Italy (n = , %).

Characteristics	1–9 years (n = 900)		10–19 years (n = 1351)		20–32 years (n = 338)		p = *
Age categories							
16–29 years	112	13.5%	45	3.7%	3	1.2%	0.001
30–39 years	199	24.0%	193	15.8%	18	7.2%	
40–49 years	303	36.5%	451	37.0%	62	24.7%	
50–59 years	216	26.0%	531	43.5%	168	66.9%	
Gender (Women)	553	61.4%	820	60.7%	226	66.9%	0.110
Origin (Rural China)	638	71.0%	976	72.5%	274	81.5%	0.001
Education categories							
No studies	58	6.7%	107	8.1%	30	9.0%	0.001
Primary/ Secondary School	391	45.0%	719	54.3%	201	60.2%	
High School	386	44.5%	469	35.4%	88	26.3%	
College or higher	33	3.8%	30	2.3%	15	4.5%	
Health insurance categories							
SSR	70	19.1%	91	27.3%	23	46.9%	0.001
STP card	45	12.3%	69	20.7%	11	22.4%	
No	251	68.6%	173	52.0%	15	30.6%	
Marital status categories							
Single	56	6.3%	36	2.7%	2	0.6%	0.001
Married	826	93.5%	1292	97.1%	324	98.2%	
Divorced	1	0.1%	2	0.2%	4	1.2%	
Speak Italian (yes)	107	29.5%	103	31.2%	19	38.0%	0.463
Current Smokers (yes)	146	16.2%	203	15.0%	39	11.6%	0.125
Abdominal Obesity (yes)	485	54.2%	786	58.6%	216	64.9%	0.003
Body Mass Index categories							
Underweight	31	3.5%	30	2.2%	2	0.6%	0.020
Normal	444	49.6%	683	50.9%	171	51.4%	
Overweight	314	35.1%	501	37.3%	133	39.9%	
Obesity	106	11.8%	128	9.5%	27	8.1%	
Blood pressure ESH categories							
Optimal	419	46.7%	527	39.3%	84	25.2%	0.001
Normal	155	17.3%	227	16.9%	42	12.6%	
High normal	119	13.3%	202	15.1%	54	16.2%	
Grade 1 hypertension	138	15.4%	242	18.0%	89	26.7%	
Grade 2 hypertension	46	5.1%	118	8.8%	50	15.0%	
Grade 3 hypertension	20	2.2%	26	1.9%	14	4.2%	
Hypertension (yes)	216	24.0%	425	31.6%	173	51.5%	0.001
Type 2 diabetes (yes)	91	10.1%	199	14.7%	66	19.5%	0.001
TG≥200 mg/dL (yes)	361	40.4%	559	42.0%	142	42.8%	0.659
TC≥240 mg/dL (yes)	145	16.3%	179	13.6%	32	9.7%	0.011
Overweight/ Obesity (yes)	420	46.9%	629	46.9%	160	48.0%	0.925

SSR = Regional Health Service; STP Card = Foreigner Temporary Present; TG = triglycerides.
TC = total cholesterol.
* = Chi squared tests.

was observed with overweight/obesity. Interestingly, hypertension was also independently associated with the origin from rural areas of China (Table 2). Age-stratified analysis was also performed considering subjects over and under 45 years of age. Prevalence of both hypertension and diabetes increased with length of stay in Italy in both groups. Conversely, favorable effects on total cholesterol, overweight/obesity, and Mediterranean diet score were mainly evident among subjects aged more than 45 years (Table 3).

Sex-stratified analysis showed that changes were entirely attributable to the female population, the male population showing only an increase in the prevalence of obesity (Fig. 1). Time spent in Italy increased the prevalence of hypertension and type 2 diabetes among Chinese women whereas no changes were observed in Chinese men (Fig. 1).

However, in Chinese women the length of residence in Italy was also associated with a favorable reduction of hypercholesterolemia and overweight/obesity (Fig. 1). Interestingly, Chinese women also showed an increased adherence to a Mediterranean Diet with length of residence in Italy, because at multivariate linear regression analysis, adjusted for the same model, the index of adherence to a Mediterranean Diet increased over time only among women (B = 0.838; 95% CI 0.386 to 1.291, $p < 0.001$ in women and B = 0.014; 95% CI -0.841 to 0.869, p = 0.974 in men). Women living in Italy 20 years or more had an OR of 2.80 (95% CI 1.55 to 5.05) for a Mediterranean Diet Score >30 vs those living in Italy <10 years.

4. Discussion

This study is the first to measure the implications of residency in Europe on cardiovascular risk within the Chinese population. In particular, the present results rely on measured rather than on self-reported data and indicate 3 main points: the length of stay in Italy is associated with a progressive increase in the prevalence of hypertension and diabetes independently of the age of the subjects; second, an effect of gender is markedly evident, because changes almost exclusively affect the female population; third, in women residency in Italy is associated with favorable changes in diet composition with a reduction of high cholesterol and overweight/obesity.

Overall, Chinese immigrants showed an increase in the prevalence of hypertension after arrival in Italy, despite the fact that this population does not appear to increase sodium consumption after immigration. In a previous study which measured sodium consumption, performed on the same cohort of Chinese immigrants, the results did not differ from the local native Italian population [20], or from what was reported by the Chinese still living in the 2 main regions of origin of the Chinese living in Prato (Zhejiang and Fujian) [20–22]. In particular, electrolyte urinary excretion was not associated with the years of residence in Italy [20]. The present study only makes use of self-reported data on adherence to the Mediterranean diet and does not consider intake on condiments, many of which are high in sodium. We acknowledge the limitation of this approach.

Interestingly, in the present study hypertension was more prevalent among participants originating from rural China. However, the rural origin was not associated with the development of obesity, diabetes, or with qualitative changes in diet as evidenced by the Mediterranean Diet score. Other elements must therefore contribute to the process.

In the present study overweight and obesity were found to increase with length of residence in Italy only among Chinese men. Overweight and obesity was consistently reported to increase with length of residence in Western countries among other ethnic groups [4,23–25]. Although information is limited for the Chinese population the obesity risk was also reported to increase among the Chinese population both in the U.S.A [26]. and in Australia [10]. The increasing prevalence of overweight/obesity and diabetes may reflect acculturation to Western lifestyles including the adoption of an unhealthy diet [24]. An increased consumption of processed food, saturated fats, sugars and soft drinks was indeed reported among the Chinese after migration to the U.S.A. [8], and Australia [10].

Physical inactivity, highly prevalent among Chinese immigrants [27], is also known to be particularly detrimental among Asian populations [28]. In Australia the prevalence of physical inactivity differed significantly by length of residence in opposite directions: the prevalence of physical inactivity was significantly higher for male Chinese living in Australia for 30 years yet was significantly lower for female Chinese [10]. Although the reasons for these sex differences are unclear, women may adapt to the cultural norms of the host country more quickly than men [29]. If this is so, it is possible that Chinese immigrant women may have been influenced by the higher levels of leisure-time

Table 2
Relationship of cardiovascular risk factors with exposures at multivariable logistic regression analysis[a].

Variables	Hypertension OR (95% C.I.)	Diabetes OR (95% C.I.)	TC ≥ 240 mg/dL OR (95% C.I.)	Overweight/Obese OR (95% C.I.)	Abdominal Obesity OR (95% C.I.)	>2 Risk Factors OR (95% C.I.)	Med. Diet Score>30 OR (95% C.I.)
Age decades	2.61 (2.25–3.03)	2.17 (1.78–2.65)	1.08 (0.93–1.25)	1.45 (1.31–1.62)	1.96 (1.75–2.19)	1.59 (1.38–1.83)	0.81 (0.64–1.02)
Sex (women)	0.80 (0.64–0.98)	0.54 (0.42–0.71)	0.46 (0.36–0.58)	0.48 (0.40–0.58)	2.37 (1.97–2.85)	0.94 (0.73–1.20)	2.54 (1.83–3.54)
Home (rural)	1.28 (1.01–1.62)	0.96 (0.71–1.30)	1.06 (0.80–1.40)	1.04 (0.85–1.27)	0.97 (0.79–1.19)	1.22 (0.94–1.58)	0.81 (0.47–1.39)
Education (cat.)	0.93 (0.79–1.09)	0.92 (0.75–1.14)	0.83 (0.68–1.01)	1.03 (0.89–1.18)	1.11 (0.96–1.29)	1.18 (0.98–1.43)	0.98 (0.75–1.29)
BMI (cat.)	1.75 (1.52–2.03)	1.38 (1.15–1.66)	0.80 (0.67–0.96)	–	–	–	–
Length of residence							
1–9 years	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10–19 years	1.16 (0.92–1.45)	1.56 (1.15–2.14)	0.73 (0.57–0.95)	0.83 (0.69–1.01)	0.96 (0.79–1.17)	0.83 (0.65–1.07)	1.59 (1.06–2.37)
20–32 years	1.85 (1.33–2.58)	1.62 (1.05–2.51)	0.52 (0.33–0.83)	0.87 (0.65–1.18)	0.91 (0.66–1.26)	1.18 (0.79–1.78)	2.09 (1.28–3.42)

TC = Total cholesterol; HOME = urban/rural area of residence in China before migration; cat. = categories.
[a] Adjusted for all exposures reported in the Table.

Table 3
Relationship of cardiovascular risk factors with length of residence in Italy at age-stratified (*< 45 years and ≥ 45 years*) multivariable logistic regression analysis[a].

Years in Italy	Hypertension OR (95% C.I.)	Diabetes OR (95% C.I.)	TC ≥ 240 mg/dL OR (95% C.I.)	Overweight/Obese OR (95% C.I.)	Abdominal Obesity OR (95% C.I.)	>2 Risk Factors OR (95% C.I.)	Med. Diet Score>30 OR (95% C.I.)
Participants aged <45 years							
1–9 years	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10–19 years	1.93 (1.17–3.18)	1.96 (1.03–3.72)	0.89 (0.60–1.32)	0.96 (0.72–1.29)	1.11 (0.83–1.48)	0.93 (0.66–1.32)	2.15 (0.87–5.32)
20–32 years	4.23 (1.95–9.18)	1.22 (0.33–4.50)	0.52 (0.18–1.52)	1.66 (0.91–3.05)	1.66 (0.90–3.04)	2.05 (1.01–4.19)	1.81 (0.55–5.96)
Participants aged ≥45 years							
1–9 years	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10–19 years	1.00 (0.77–1.29)	1.49 (1.05–2.13)	0.68 (0.49–0.94)	0.77 (0.60–0.99)	0.81 (0.62–1.06)	0.71 (0.49–1.03)	1.33 (0.85–2.08)
20–32 years	1.53 (1.06–2.20)	1.61 (1.01–2.58)	0.49 (0.29–0.84)	0.68 (0.48–0.97)	0.77 (0.53–1.13)	0.85 (0.51–1.43)	2.11 (1.22–3.63)

TC = Total cholesterol.
[a] Adjusted also for sex, urban/rural area of residence in China before migration, education, BMI categories.

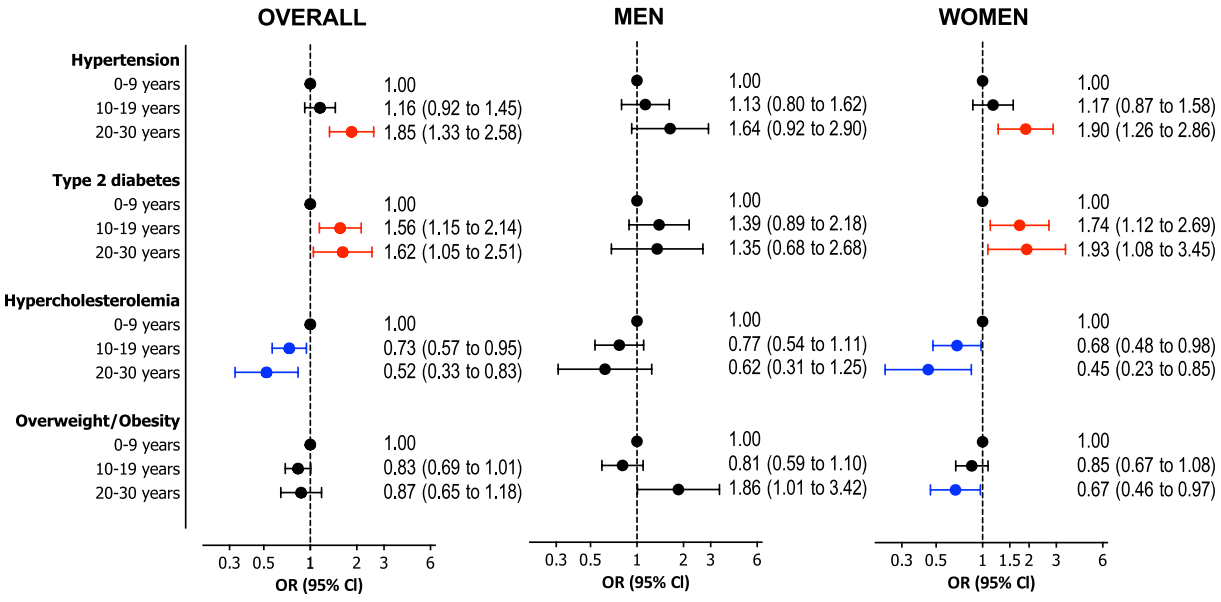

Fig. 1. Adjusted ORs (with 95% CI) for hypertension, type 2 diabetes, hypercholesterolemia, and overweight/obesity with years of residence in Italy in the overall cohort, in men, and in women.

physical activity in their host country, Australia [10].

It Italy, where great attention is paid to healthy food rather than to physical activity, especially among women [30], changes in diet composition among the Chinese were also more evident in women than in men. More precisely, Chinese women changed their diet quality also achieving weight reduction, although with no changes in type 2 diabetes prevalence. Furthermore, years spent in Italy were also associated with a reduction of hypercholesterolemia among Chinese women. In a recent qualitative study performed in Spain Chinese women were also reported to be more careful with their eating habits than men [31]. Conversely strong adherence to traditional habits was observed among Chinese immigrant men who consider smoking and alcoholic beverages social behavior [32]. However, a trend towards cultural integration was identified when Chinese immigrant men combine typical alcoholic beverages from both cultures and countries, such as beer and high-strength Chinese spirits [32]. In the present study adherence to dietary recommendations, expressed using the Mediterranean Diet score, was also found to increase with length of residence in Italy only among women.

This study includes a series of limitations. First, the association

between length of stay in Italy and risk factors is based on cross-sectional analysis without causal inferences and should be interpreted with caution. Second, the assessment of nutritional habits was based on a large-scale dietary score that incorporated the intrinsic characteristics of the Mediterranean food pattern [18]. The questionnaire focuses on the intake of specific nutrients but may tend to underestimate the intake of various condiments (e.g. salt, soy sauce, red pepper paste, soy paste, etc.) and cooking oils which contribute significantly to nutrients of the Asian diet. In addition, diet assessments were only performed once, which could lead to errors in the estimates. Third, a potentially significant limitation of this study is the uneven distribution of age between the three length of stay categories. However, age was included in all regression models and relationships appear to be independent of age. Furthermore, age-stratified analysis was performed considering subjects over and under 45 years of age. Prevalence of both hypertension and diabetes increased with length of stay in Italy in both groups. Conversely, favorable effects on total cholesterol, overweight/obesity, and Mediterranean diet score were mainly evident among subjects aged more than 45 years. Fourth, the study cohort was collected on a voluntary basis rather than being randomly selected from population lists. However, this point could in fact be seen as a main strength of the study because it permitted the study of a large number of undocumented immigrants who are often excluded from population surveys. This point was made possible by the strong collaboration with the Chinese community which hosted the prevention and screening center within its own buildings, making the Chinese population more likely to take part. Indeed, it should be stressed that a large section of this undocumented population would otherwise not have gone to conventional health facilities. To our knowledge this is the first time that such a model of approach has been implemented in Europe, and the collaboration of the Chinese community was most important.

A main strength of the present study is that all risk factors were measured using standardized methodologies rather than being self-reported as happened in the previous studies performed on Chinese immigrants in the United States [8], Canada [9], and Australia [10].

First generation Chinese immigrants were previously found to have a higher prevalence of hypertension and main risk factors than the Italian population independently from socioeconomic conditions [13,14]. Importantly rate of hypertension treatment was found to be lower in the Chinese than in the Italian cohort, although comparable levels of awareness [13]. Specific prevention strategies have thus to be implemented in the Chinese community.

The present study contributes to finding links between risk factors and the acculturation process, which may be useful to proactively develop and implement interventions to improve CVD risk among Chinese immigrants.

Author statement

Pietro Amedeo Modesti: Conceptualization, Study design, Data Formal analysis, Writing – original draft preparation, Supervision. Ilaria Marzotti: investigation, Methodology, Analysis and interpretation of the data. Maria Calabrese: Investigation, Methodology, Analysis and interpretation of the data. Laura Stefani: Investigation, Data curation. Loira Toncelli: Investigation, Data curation. Giorgio Galanti: Investigation, Data curation. Maria Boddi: Writing- Reviewing and Editing. Alessandra Modesti: Writing- Reviewing and Editing. All the Authors revised the manuscript critically, gave final approval, and agreed to be accountable for all aspects of the work, ensuring integrity and accuracy.

Funding disclosure

This research was partially supported by a grant from the National Institute for Health, Migration and Poverty (INMP), Istituto Nazionale per la promozione della salute delle popolazioni Migranti e per il contrasto delle malattie della Povertà (INMP), Rome, Italy.

Conflict of interest statement

None. The authors have no competing interests to declare.

Acknowledgement

The authors thank all the Chinese individuals who participated in the study; the Consul General of the People's Republic of China (Dr. Wang Fuguo), Mr. Yang Wang (Consul), and Mr. Chen Hong Sheng (Friendship Association of Chinese in Prato) for providing the necessary support to interact with the Chinese Community; Jing Yang, Wang Xiaoling, Zhang Mengyue, Yang Zihua, Guo Jia, Sonia Fligor, Franco Macri' and Coop 22 Cooperativa Sociale Onlus, Prato, for their contribution in the acquisition of data.

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