Ann Ist Super Sanità 2022 | Vol. 58, No. 2: 109-117
DOI: 10.4415/ANN_22_02_06



# Monitoring cardiovascular diseases and associated risk factors in the adult population to better orient prevention strategies in Italy

**Viviana Santoro[1], Valentina Minardi[2], Benedetta Contoli[2], Rosaria Gallo[3], Valentina Possenti[2], PASSI and PASSI d'Argento National Coordinating Group* and Maria Masocco[2]**

[1]*Dipartimento di Sanità Pubblica, Unità Operativa Igiene e Sanità Pubblica, Ravenna, Ausl Romagna, Ravenna, Italy*
[2]*Centro Nazionale per la Prevenzione delle Malattie e la Promozione della Salute, Istituto Superiore di Sanità, Rome, Italy*
[3]*Assistenza Sanitaria, Distretto Sanitario 9, ASL Roma 2, Rome, Italy*
**The members of the PASSI and PASSI d'Argento National Coordinating Group are listed before the references*

**Abstract**

***Introduction.*** Cardiovascular disease (CVD) is the first cause of death in Europe and over the world. This study analyses health-related behaviours in adults referring doctor-diagnosed CVDs.

***Materials and methods.*** We used data from the Italian cross-sectional Behavioural Risk Factor Surveillance System PASSI gathered in 2015-2018. Complex survey design analyses included the Taylor series method for variance estimation and Poisson regression for associations between socio-demographic characteristics and CVD.

***Results.*** Among 132,598 respondents, the prevalence of doctor-diagnosed CVD was 5%. Higher percentages are observed among: men, older individuals, socioeconomically disadvantaged people. Compared to the general population, people with CVD have greater risk and aggravating factors, and a worse health status overall. All protective behaviors and lifestyles shall be improved.

***Discussion and conclusions.*** In Italy, adults with CVD are more likely to be exposed to aggravating modifiable risk factors: it represents a valuable information for increased preventive interventions, even more in the light of the COVID-19 pandemic scenario.

**Key words**

- cardiovascular diseases
- risk factors
- surveillance
- epidemiology
- prevention

## INTRODUCTION

Nowadays, in Europe and other world regions, lengthening of average life and constant increase of population ageing on the one hand and a constantly decreasing natality on the other hand have determined an increasing relative weight of causes for morbidity and mortality most associated with the decline of the organism, such as chronic noncommunicable conditions. Thus, despite the huge scientific and technology advances in their prevention, diagnosis and treatment, cardiovascular diseases (CVDs) are by far the leading cause of death worldwide [1].

In Europe, slightly over 1.8 million people died from diseases of the circulatory system, mainly corresponding with heart attacks and strokes. These conditions were the two major causes of deaths in the European Union (EU) responsible for 36% and 26% of all deaths respectively, despite large decrease in CVD mortality [2]. In Italy, since 1990, a significant decline of CVD burden, particularly in the age-standardised prevalence (-12.7%), mortality rate (-53.8%), and disability-adjusted life years rate (-55.5%) has been observed. In spite of such a success in reducing disability, premature death and early incidence of CVDs, their burden is still high: all-age prevalence CVD increased from 5.75 to 7.49 million residents in Italy and CVDs confirm to be the first cause of death (34.8% of total mortality). Additionally, more than 80% of the CVD-related burden could

*Address for correspondence*: Valentina Possenti, Centro Nazionale per la Prevenzione delle Malattie e la Promozione della Salute, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy. E-mail: valentina.possenti@iss.it.

be attributed to known modifiable risk factors such as high systolic blood pressure, dietary risks, high low density lipoprotein cholesterol, and impaired kidney function [3].

Given projections by 2030 of more than annually 22.2 million deaths from CVDs, the World Health Organization (WHO) introduced a global prevention agenda, which emphasizes the role of cardiovascular prevention and control, and aims to increase research capacity in the field of preventive cardiology to meet the reduction of one-third of premature deaths [4]. CVDs are associated with a relevant burden on healthcare systems, and on society as well. Overall, the impact of CVD on population health could be improved by addressing behavioural risk/aggravating factors, such as tobacco smoking, physical inactivity, overweight and/or obesity, along with the implementation of preventive measures that are weight loss and smoking cessation or involving appropriate treatments for hypertension, and diabetes mellitus among at risk population. Additionally, CVDs relate to a low socioeconomic status (SES): they do not in fact equally distribute in the population and mostly affect deprived groups [5]. Lifestyle-based preventive cardiology aims to combat the CVD burden by behavioural interventions [6].

We used data from the Behavioural Risk Factor Surveillance System (BRFSS) PASSI (Progressi delle Aziende Sanitarie per la Salute in Italia) to estimate CVD in the adult population (18-69 years) in Italy and describe their health profile. More in detail, the specific objectives are: (i) to estimate the CVD prevalence, overall and in different groups; (ii) to assess the occurrence of CVD behavioural risk factors in people with and without CVD. Such these figures are relevant to identify gaps in prevention and plan effective preventive policies and better-tailored health promotion interventions.

## MATERIALS AND METHODS

### *Data source and study population*

PASSI is an ongoing cross-sectional Italian BRFSS that originated by express commitment of the National Centre for Disease Prevention and Control of the Italian Ministry of Health: the National Institute of Health (Istituto Superiore di Sanità; ISS) is in charge of its central coordination, but it is carried on by Regions and Local Health Units (LHUs) [7, 8]. Since 2008, PASSI has been monitoring the prevalence of the major behavioural risk factors for chronic noncommunicable diseases and compliance level to the main preventive measures among the adult population (18-69 years of age) living in Italy. PASSI represents a useful tool for Regions and LHUs to describe the general population health profile, in order to plan health promotion and prevention interventions and monitor their effectiveness over time towards the objectives of the National Prevention Plan (NPP) [9].

In each LHU participating in the surveillance, the PASSI monthly sample is extracted by a random modality from an enrolment list of residents and is stratified by gender and age (18-34, 35-49, 50-69 years) in the same proportion than the reference population. Specially trained personnel from the LHUs' public health departments administer telephone interviews using a standardised questionnaire. Eligibility PASSI criteria are: falling within the target age range (18-69 years), being reachable on a telephone number (landline or mobile), not being hospitalised nor institutionalised, understanding the Italian language (in the autonomous province of Bolzano the interviewees have the option of being interviewed in German), and having the ability to participate in the interview. The PASSI operational protocol encompasses the field-substitution technique. Once data are collected, they are anonymised and electronically recorded in a national database, and an annual dataset is created by aggregation of the interviews, which are finalised in the calendar year. Furthermore, four-year datasets are combined to ensure adequate sample size for allowing population subgroups explorations. By the way, PASSI methods for data collection have been described more in detail elsewhere [10].

In the period 2015-2018, 133,070 people (almost 90% of adult population overall) were interviewed in more than 90% LHUs (89 out of 101 in 2018). Adults aged 18-69, resident in Italy, totalled 40,769,022 individuals on January 2017, 1st. The outcome rates are calculated according to the guidelines of the American Association for Public Opinion Research and the Response Rate is 80% in 2018 [11].

### *Indicator definitions*

Information on CVDs are retrieved by asking the interviewees if a physician has ever diagnosed or confirmed any of the following: (i) myocardial infarction, cardiac ischaemia or coronary disease; (ii) other heart diseases such as heart failure or valvulopathy; (iii) stroke or cerebral ischaemia. The analysis considered people who referred at least one of these health conditions. PASSI collects also data on socio-demographic characteristics such as: gender, age, educational level (none or primary school, middle school, high school, university), economic difficulties in making ends meet by the available financial resources (many, some or not at all), nationality (Italian or other) and geographic residence area as categorised by the National Institute of Statistics criteria (North, Centre, South and major islands).

This study focuses on four cluster topics related to CVD prevention. Two groups of indicators related to health and risk profile of people with CVD: (i) health status (number of unhealthy days), depressive symptoms screened by the Patient Health Questionnaire 2 (PHQ-2) [12], referred diagnoses of any chronic disease, (ii) cardiovascular risk factors (CVRFs) as diabetes, hypertension, raised blood cholesterol, overweight/obesity, and modifiable lifestyle risk factors (tobacco smoking, higher risk alcohol consumption, physical inactivity, poor daily consumption of fruit and vegetable). The other two variable categories concern preventive measures of CVD risk: (iii) compliance with protective factors; (iv) advice by healthcare professionals on correct lifestyles promotion (such as to quit smoking, lose weight, engage in regular physical activity, reduce salt and alcohol consumption).

***Statistical analysis***

Different analyses of the 2015-2018 dataset included, first, estimation of prevalence, and relative 95% confidence intervals (95% CI), of CVD burden and as per types: (i) ischaemic heart disease, that is myocardial infarction, cardiac ischaemia or coronary disease; (ii) other heart diseases, such as heart failure or valvulopathy; (iii) stroke or cerebral ischaemia. We estimated CVD prevalence overall in subgroups by socio-demographic characteristics. Secondly, we described the health profile and quality of life, the occurrence of modifiable risk/aggravating factors for CVD, protective behaviours and to what extent General Practitioners (GPs) and healthcare workers advice CVD-diagnosed people on healthy lifestyles in comparison with people without CVD [13]. Prevalence estimates are weighted (at regional and national levels) by assigning each record a probability weight equal to the inverse of the sampling fraction in each LHU stratum.

The statistical package STATA 13 software (StataCorp LP) supplied data analysis.

Complex survey design analyses were conducted, using the Taylor series method for variance estimation. To estimate prevalence for principle indicators from PASSI data, the function of STATA required specification for the strata, primary sampling units, sampling weights or probabilities. Standard errors are computed using Taylor series linearisation.

A Poisson regression with robust variance was used first to estimate adjusted prevalence ratios for evaluating the association between CVD and socio-demographic characteristics and then to compare health and risk profile of people with CVD versus people without CVD. Cross-sectional studies with binary outcomes analysed by logistic regression are frequent in the epidemiological literature. However, the odds ratio can importantly overestimate the prevalence ratio. On the contrary, Poisson models with adjusted variances provide correct point and interval estimates, and the advantage being the prevalence ratio as the measure of association, it therefore represents not only a viable model other than logistic regression to analyse cross-sectional data with binary outcomes, but also more interpretable and easier to communicate, especially to a non-epidemiologist audience [13].

All prevalence ratios are adjusted for gender, age, educational level, perceived economic difficulties, nationality and geographic area of residence.

## RESULTS

A total of 133,070 people was interviewed from 2015 to 2018; the analysis considered 132,598 records actually, because 472 were missing in CVD items. The distributions of the sample by age and gender closely reflect those of the resident population for the years and geographical areas considered [14]. The CVD prevalence in the adult population in Italy was 5% (stroke and ischaemia 0.82%, myocardial infarction, cardiac ischaemia or coronary disease 1.89%, and other heart diseases 2.97%) *(Table 1)*. The CVD prevalence was significantly higher in the following subpopulations: older persons *vs* 18-34 years (35-49 and 50-69 years; adj. PR=2.75, p<0.001 and adj. PR=9.69, p<0.001), people with lower educational level *vs* graduates (high school adj.PR=1.11, p=0.032; compulsory school adj.PR 1.26, p<0.001; and primary school or none adj. PR=1.81, p<0.001), individuals who referred some or many economic difficulties (adj. PR=1.18; p<0.001 and adj. PR=1.62; p<0.001, respectively *vs* people without difficulties), residents in the North *vs* in the Southern Italy (adj. PR=1.08; p=0.029). Women result to be less affected by CVD than men (4.2% *vs* 5.9%; adj. PR=0.67; p<0.001) as well as foreign citizens in comparison with Italians (2.8% *vs* 5.1% adj. PR 0.73; p<0,001) *(Table 1)*.

The *Table 2* compares health status, quality of life, cardiovascular risk and modifiable risk/aggravating factors in people with and without cardiovascular diseases. Data show a worse perceived health and quality of life profile among people diagnosed with CVD than the rest of the sample: they state to feel unwell, bad or very bad, three times more (68.5% *vs* 27.5%; adj. PR=3.3, p<0.001) and to have lived more than 14 unhealthy days in the last month, both related to physical (19.1% *vs* 5.3%; adj. PR=3.3 p<0.001) and psychological health (16.4% *vs* 6.3%; adj. PR=2.6 p<0.001), as well as per daily activity limitations (12.2% *vs* 2.6%; adj. PR=3.4 p<0.001). People affected by CVD reported to suffer from these health issues two times more frequently than others: depressive symptoms (14.1% *vs* 5.5%; adj. PR=2.0, p<0.001) and at least one chronic disease among cancers, respiratory diseases, renal failure, diabetes or liver diseases (40.1% *vs* 13.8%; adj. PR=2.4, p<0.001). The CVD group refers CVRFs more frequently than others: diabetes diagnosis (18.6% *vs* 4%; adj. PR=2.4, p<0.001), hypertension (55.9% *vs* 17.8%; adj. PR=3.0, p<0.001), high cholesterol (44.2% *vs* 21.3%; adj. PR=1.9, p<0.001) and overweight/obesity (61.1% *vs* 41.5%; adj. PR=1.3, p<0.001). Individuals with CVD have never abandoned unhealthy habits such as smoking, alcohol use at risk, physical inactivity and low consumption of fruit and vegetables that, as well as CVRF, represent aggravating factors for the progression of CVD they are affected by, for the onset of new cardiovascular events and other noncommunicable diseases (NCDs). Compared to people without CVD, among people with CVD we observed slightly lower prevalence for tobacco smoking (22.3% *vs* 25.9%; adj. PR=0.9, p<0.001) and at-risk alcohol consumption (12.1% *vs* 17.4%; adj. PR=0.9, p=0.002), even if the figure is not significant for usual high drinking (4.0% *vs* 3.0%; adj. PR=0.9, p=0.233); whereas physical inactivity is very more frequent (43.3% *vs* 34.0%; adj. PR=1.2, p<0.001), but low fruit and vegetable consumption is nearby comparable (52.5% *vs* 48.9%; adj. PR=1, p=0.149).

With regard to protective behaviours, people with CVD show to be much more compliant than CVD-free group, except for engaging in leisure-time physical exercise; there is not instead significant difference in reaching out the "five a day" formula for fruit and vegetable consumption *(Table 3)*. The compliant behaviour in CVD-diagnosed individuals is verified for: attempts to quit smoking in the previous 12 months (45% in CVD group *vs* 32.9% among those without any CVD; adj. PR=1.8, p<0.001), being on diet to lose weight if obese

**Table 1**
Distribution and prevalence of cardiovascular diseases, association with socio-demographic characteristics by Adjusted Prevalent Ratios (Poisson Regression Model). PASSI 2015-2018 (n = 132,598)

| Characteristics | All sample (n=132,598) | Cardiovascular disease-diagnosed people (n=6,545) | | | | |
|---|---|---|---|---|---|---|
| | Distribution | Prevalence | | Adjusted Prevalence Ratio[a] | | |
| | % | % | (95% CI) | Adj.PR | (95% CI) | p value |
| **Age group** | | | | | | |
| 18-34 | 26.5 | 0.9 | (0.8-1.0) | 1.00 | - | - |
| 35-49 | 33.4 | 2.6 | (2.4-2.8) | 2.75 | (2.38-3.17) | p<0.001 |
| 50-69 | 40.0 | 9.8 | (9.5-10.2) | 9.69 | (8.49-11.1) | p<0.001 |
| **Gender** | | | | | | |
| Male | 48.9 | 5.9 | (5.6-6.1) | 1.00 | - | - |
| Female | 51.1 | 4.2 | (4.0-4.4) | 0.67 | (0.63-0.71) | p<0.001 |
| **Education level** | | | | | | |
| University | 17.3 | 3.1 | (2.8-3.4) | 1.00 | - | - |
| High school | 48.0 | 3.9 | (3.7-4.1) | 1.12 | (1.01-1.23) | p=0.032 |
| Middle school | 28.8 | 6.4 | (6.1-6.7) | 1.26 | (1.13-1.39) | p<0.001 |
| Primary school or none | 5.9 | 12.9 | (12.0-13.9) | 1.81 | (1.60-2.04) | p<0.001 |
| **Economic difficulties*** | | | | | | |
| None | 46.7 | 4.2 | (4.0-4.4) | 1.00 | - | - |
| Some | 39.9 | 5.1 | (4.9-5.4) | 1.18 | (1.10-1.26) | p<0.001 |
| Many | 13.4 | 7.7 | (7.2-8.2) | 1.62 | (1.49-1.77) | p<0.001 |
| **Geographic area of residence[§]** | | | | | | |
| North | 37.1 | 5.1 | (4.9-5.3) | 1.08 | (1.01-1.16) | p=0.029 |
| Centre | 22.7 | 4.5 | (4.3-4.8) | 0.97 | (0.90-1.05) | p=0.472 |
| South | 40.1 | 5.2 | (4.9-5.5) | 1.00 | - | - |
| **Nationality** | | | | | | |
| Italian | 95.4 | 5.1 | (5.0-5.3) | 1.00 | - | - |
| Other | 4.6 | 2.8 | (2.4-3.3) | 0.73 | (0.62-0.86) | p<0.001 |

[a]Adjusted prevalence ratio for: gender, age, educational level, perceived economic difficulties, nationality and geographic area of residence).
*Self-reported difficulties in making ends meet by the available financial resources.
[§]The Southern Italy includes the two major islands (Sardinia and Sicily) as per census criteria by the Italian National Institute of Statistics.

or overweight (34.7% *vs* 24.2%; adj. PR=1.6, p<0.001), uptake of the seasonal flu vaccination (30.4% *vs* 8.4%; adj. PR=2.6, p<0.001). Data highlight also that health professionals advise people affected by CVD on healthy lifestyles more than non-CVD people, with concern to all the six items investigated (quitting smoking, losing weight if overweight/obese or in presence of high cholesterol, engaging in physical activity, reducing higher risk alcohol consumption, reducing salt use if blood pressure is high). The major health professions' advice to CVD group is just slightly higher for the suggestion on reducing salt consumption to people with elevated blood pressure.

## DISCUSSION

### *CVD prevalence and comparison with other sources*

In Italy, the PASSI surveillance system is a unique epidemiological source that, basing on a continuous data collection on randomised specific groups of resident population, allows global health data analysis. Furthermore, experiences of comparison with health data of hospital admissions are very few and limited because of selection bias; thus, any accurate rate of diagnosis is confirmed so far. It is noteworthy that administrative data and local registries present widely different encoding data collecting. Other Italian sources reveal a comparable prevalence of CVD: the National Institute of Statistics calculates a 3.9% prevalence of heart diseases (heart attacks and other) by its cross-sectional health interview survey in 2015. Others appreciated a valuable CVD burden in Italy where, over ten years (2008-2012), the prevalence of myocardial infarction remained stable (1.6% in men; about 0.5% in women) and that of stroke decreased in men (from 1.2% to 0.7%) [15]. In 2020, the GBD 2017 Italy Cardiovascular Diseases Collaborators found an increase in all-age prevalence of CVD from 5.75 to 7.49 million Italian residents [3].

### *Socio-demographic factors*

PASSI data show higher CVD prevalence in men, older persons and socioeconomically disadvantaged groups. These results by age and gender are comparable with data from other Italian and European statistic studies. According to Eurostat, in the EU in

**Table 2**
Prevalence (95% CI) of health status/quality of life, cardiovascular risk factors, modifiable risk/aggravating factors in people with and without cardiovascular diseases (CVDs) by Crude/Adjusted Prevalent Ratios (Poisson Regression Model). PASSI 2015-2018 (n = 132,598)

| Variables | | People w/CVDs (n=6,545) | People w/o CVDs (n=126,053) | People w/CVDs vs People w/o CVDs | | | |
|---|---|---|---|---|---|---|---|
| | | % (95% CI) | % (95% CI) | Crude PR[a] | p-value | Adj. PR[b] | p-value |
| **Health status/ quality of life** | Bad health status perceived | 68.5 (67.1-69.9) | 27.5 (27.2-27.8) | 5.195 | <0.001 | 3.309 | <0.001 |
| | +14 unhealthy days (physical health) | 19.1 (17.9-20.4) | 5.3 (5.2-5.5) | 4.747 | <0.001 | 3.319 | <0.001 |
| | +14 unhealthy days (psychological health) | 16.4 (15.3-17.6) | 6.3 (6.1-6.5) | 3.147 | <0.001 | 2.634 | <0.001 |
| | +14 unhealthy days (daily activity limitations) | 12.2 (11.1-13.3) | 2.6 (2.5-2.7) | 5.084 | <0.001 | 3.381 | <0.001 |
| | Depressive symptoms (PHQ-2) | 14.1 (13.0-15.3) | 5.5 (5.4-5.7) | 2.589 | <0.001 | 2.029 | <0.001 |
| | At least one chronic disease* | 40.1 (38.6-41.6) | 13.8 (13.6-14.1) | 3.757 | <0.001 | 2.360 | <0.001 |
| **Cardiovascular risk factors** | Diabetes^ | 18.6 (17.4-19.9) | 4.0 (3.9-4.2) | 4.581 | <0.001 | 2.380 | <0.001 |
| | High blood pressure§ | 55.9 (54.4-57.5) | 17.8 (17.5-18.1) | 5.122 | <0.001 | 2.992 | <0.001 |
| | High cholesterol° | 44.2 (42.6-45.8) | 21.3 (21.0-21.6) | 2.706 | <0.001 | 1.875 | <0.001 |
| | Overweight/ obesity | 61.1 (59.6-62.6) | 41.5 (41.1-41.8) | 2.134 | <0.001 | 1.347 | <0.001 |
| **Modifiable risk/ aggravating factors** | Tobacco smoking | | | | | | |
| | Current smokers | 22.3 (21.0-23.6) | 25.9 (25.6-26.2) | 0.830 | <0.001 | 0.867 | <0.001 |
| | Former smokers | 34.6 (33.2-36.1) | 16.7 (16.4-16.9) | 2.488 | <0.001 | 1.761 | <0.001 |
| | Alcohol consumption | | | | | | |
| | Higher risk# | 12.1 (11.2-13.1) | 17.4 (17.1-17.6) | 0.671 | <0.001 | 0.876 | 0.002 |
| | Usual | 4.0 (3.5-4.6) | 3.0 (2.9-3.1) | 1.325 | <0.001 | 0.920 | 0.233 |
| | Binge drinking | 7.2 (6.5-8.0) | 9.4 (9.2-9.6) | 0.758 | <0.001 | 0.892 | 0.042 |
| | Between meals | 3.6 (3.2-4.1) | 8.5 (8.3-8.7) | 0.417 | <0.001 | 0.938 | 0.368 |
| | Physical inactivity | 43.3 (41.7-44.8) | 34.0 (33.7-34.3) | 1.450 | <0.001 | 1.218 | <0.001 |
| | Low fruit and vegetable consumption (≤2 portions/day) | 52.5 (51.0-54.0) | 48.9 (48.6-49.3) | 1.146 | <0.001 | 1.045 | 0.149 |

[a]Crude prevalence ratio.
[b]Adjusted prevalence ratio for: gender, age, educational level, perceived economic difficulties, nationality and geographic area of residence.
*Among cancers, respiratory diseases, diabetes, renal failure, liver diseases.
^People told by a doctor that they have diabetes.
§People told by a doctor that they have high blood pressure.
°People told by a doctor that they have high cholesterol.
#This category includes people who, in the previous 30 days, had one or more of the following alcohol consumption modalities: usually high (consuming on average >2 for men and >1 for women alcohol units per day), binge drinking (consuming ≥5 for men and ≥4 for women alcohol units in a unique occasion), exclusively or mostly between meals.

2016 over 609,000 deaths (one in eight overall) were due to coronary diseases, with a rate of deaths from coronary heart diseases standing at 1,190 deaths per million inhabitants. In every EU Member State, the age-standardised rate of men dying from coronary heart diseases was higher than for women, with 1,620 deaths per million men compared to 870 deaths per million women; for Italy, the rates were 148 deaths per 100,000 in men and 96 deaths per 100,000 in women. CVD is often considered a disease of older age, and in-

**Table 3**
Prevalence (95% CI) of protective behaviours and advice on healthy lifestyles by health professionals in people with and without cardiovascular diseases (CVDs) by Crude/Adjusted Prevalent Ratios (Poisson Regression Model). PASSI 2015-2018 (n = 132,598)

| Variables | | People w/CVDs (n=6,545) | People w/o CVDs (n=126,053) | People w/CVDs vs People w/o CVDs | | | |
|---|---|---|---|---|---|---|---|
| | | % (95% CI) | % (95% CI) | Crude PR[a] | p-value | Adj. PR[b] | p-value |
| **Protective behaviours** | Current smokers attempting to quit smoking | 45.0 (41.6-48.4) | 32.9 (32.2-33.6) | 1.628 | p<0.001 | 1.754 | p<0.001 |
| | Overweight/obese people on diet | 34.7 (32.9-36.6) | 24.2 (23.7-24.7) | 1.598 | p<0.001 | 1.631 | p<0.001 |
| | Engaging in leisure-time physical activity | 53.2 (51.6-54.7) | 61.2 (60.8-61.5) | 0.733 | p<0.001 | 0.893 | p<0.001 |
| | Reaching out five a day | 11.9 (11.0-12.8) | 9.9 (9.7-10.1) | 1.210 | p<0.001 | 1.085 | p=0.063 |
| | Seasonal flu vaccine uptake (last campaign)* | 30.4 (28.3-32.5) | 8.4 (8.1-8.7) | 4.154 | p<0.001 | 2.566 | p<0.001 |
| **Advice on healthy lifestyles by health professionals** | Current smokers advised to quit smoking | 77.7 (74.8-80.3) | 50.1 (49.3-50.8) | 3.284 | p<0.001 | 2.551 | p<0.001 |
| | Overweight/obese people advised to lose weight | 65.5 (63.5-67.4) | 45.9 (45.3-46.5) | 2.099 | p<0.001 | 1.994 | p<0.001 |
| | Inactive people advised to engage in regular physical activity | 41.4 (38.9-43.9) | 26.1 (25.5-26.7) | 1.892 | p<0.001 | 1.711 | p<0.001 |
| | Higher risk alcohol consumers# advised to drink less | 14.4 (11.5-17.9) | 6.1 (5.6-6.5) | 2.461 | p<0.001 | 1.685 | p<0.001 |
| | People with high blood pressure§ advised to reduce using salt | 88.4 (87.0-89.7) | 85.4 (84.8-86.0) | 1.256 | p<0.001 | 1.173 | p=0.011 |
| | People with high cholesterol° advised to lose weight | 57.6 (55.2-59.9) | 43.2 (42.3-44.1) | 1.666 | p<0.001 | 1.539 | p<0.001 |

[a]Crude prevalence ratio.
[b]Adjusted prevalence ratio for: gender, age, educational level, perceived economic difficulties, nationality and geographic area of residence.
*PASSI data refer to the time interval 2015-2018; interviewees report compliance with seasonal flu vaccination in the previous yearly campaign.
#This category includes people who, in the previous 30 days, had one or more of the following alcohol consumption modalities: usually high (consuming on average >2 for men and >1 for women alcohol units per day), binge drinking (consuming ≥5 for men and ≥4 for women alcohol units in a unique occasion), exclusively or mostly between meals.
§People told by a doctor that they have high blood pressure.
°People told by a doctor that they have high cholesterol.

deed its prevalence does rise with age. However, CVD is responsible for many premature deaths in men and women - around 192,000 people die before the age of 65 (22% of all deaths under 65 years) in the EU [2]. It is widely acknowledged that the risk of developing CVD is inversely related to SES in high income countries, and low SES is associated with worse health outcomes, even if access to medications is equitable. In deprived people, we found a higher CVD prevalence than in advantaged people, which is a consistent result [5]. Even if a non-Italian nationality appears to work as a protection factor, we verified a better cardiovascular health to foreign citizens, but we cannot exclude social vulnerability as barriers in accessing early diagnosis and effective treatments. Conversely, several studies actually show that migrant status could be a marker of social vulnerability only for some ethnic groups with high CVD incidence [16]. The absence of geographic gradient should be framed within the study of other aspects, such as the effect of mortality rate, effectiveness and accessibility to treatments; therefore, continued collection of epidemiological data stratified by socio-demographic characteristics is necessary.

### *Modifiable factors*

The majority of individuals has at least one NCD before death and, given that CVD represents a major disease group [3], lifestyle-based preventive cardiology has a growing research footprint. PASSI findings on people who outlived a CVD event show quite alarming levels as per the four modifiable lifestyle risk factors associated to NCDs. Tobacco smoking is the leading cause of CVD morbidity and mortality, and the relation of this habit to the risk for developing up to 36 different subtypes of CVD, across fatal and non-fatal outcomes, is an actual research subject [17]. From the analysis drawn by PASSI, although the prevalence of current smokers among CVD-patients is lower than the one detected in CVD-free people and, conversely, the former is much keener to quit smoking, however this unhealthy behaviour is adopted by more than a fifth of CVD-diagnosed individuals. If the lower figure of at-risk alcohol consumption among CVD individuals is in line with the strong evidence of cardiovascular health benefiting from decreasing or moderate alcohol consumption [18], scarce consumption of fruit and vegetable (i.e., ≤2 servings per day) hardly occurs regardless of suffering from CVD.

On the contrary, it is worrisome the increased percentage of physically inactive people with CVD because, during the last decade, it has been confirmed how much sedentary behaviour, especially time spent sitting, represents a major CVD risk factor by 15%. Wijndaele *et al*. proved that one additional hour per day spent watching TV is associated with an augmented 6% CVD risk, rising to 8% for the solely coronary disease [19], and on a mid-age female sample, being seated at least 10 hours per day increases the CVD risk by 18% compared to a sedentariness ≤5 hours per day [20].

As expected, in the CVD group raised blood pressure, overweight and/or obesity, high blood cholesterol and diabetes exceed the values characterising CVD-free population. Increased risk of developing CVRF can potentially increase the CVD risk, and exposure to CVRFs during early adulthood is associated with adverse cardiovascular outcomes in later life [21]. Being affected by a CVD represents a health outcome, but also a risk itself: this is evident in the burden of disease reported by CVD patients who suffer from at least one NCD thrice more than CVD-free people as well as from a poor-quality state of living overall and depressive symptoms. The INTERHEART study identified the five major behavioural factors which, together, account for >80% of the incidence of myocardial infarction, and the risk cumulative effects directly relate to the increased number of premature deaths [22]. In addition to that, whereas lifestyle modification is a proven cost-effective mean of reducing premature deaths through both population-based and individual preventive interventions, people with established CVD do not achieve behavioural targets – particularly in smoking and obesity – even though interventions such as a family-based multidisciplinary programme that offers risk reduction interventions to high-risk patients [23].

Although the current Italian NPP 2020-2025 further recognises and acknowledges modifiable lifestyles as health priority issues [9], PASSI shows that preventive cardiology can be further improved in individuals who may be at risk and in those with established disease [6]. Medical advice on healthy lifestyles that is a clearly effective action is nevertheless practiced too little and mainly applied to reduce a certain risk rather than develop specific preventive interventions. A population-based study on individuals without CVD (primary prevention sample) *vs* CVD patients found that a physician-led lifestyle advice is less frequent in the primary prevention sample [24]. The combined presence of hypertension and hypercholesterolemia increases considerably the risk for cardiovascular complications: consequently, non-pharmacological treatment includes weight reduction, appropriate dietary measures such as alcohol and salt restriction, cessation of smoking and increasing physical activity [25]. PASSI indicated low values of health professionals' advice overall, but some issues such as alcohol drinking seem even more neglected if compared to others, as salt use, typically envisaged as relating to cardiovascular health.

Lastly, CVD represents not only a disease condition but also a further aggravating risk in case of infectious diseases: some evidence is available on that about seasonal influenza and already consistently in case of COVID-19 infection, as well. CVDs are in fact associated with significantly worse outcomes in COVID-19 patients [26]. Moreover, the burden of disasters seems to have indirect long-term effects on cardiometabolic health [27] and even COVID-19 pandemic could have such long-term repercussions of cardiometabolic parameters that, in turn, expose to greater risk of CVD. Against this new backdrop, primary prevention is essential to reduce the incidence of CVD overall as well as, in patients with CVD, the control of clinical parameters, through appropriate therapy on the one hand and by monitoring and contrasting unhealthy lifestyle on the other.

### *Strengths and limitations*

The main strength of the study is about the representative sample of the general population in age 18-69 years living in Italy. It means also that data analysis including specific groups of randomised resident population are selection bias free. The PASSI information is currently used both at local such as regional level to evaluate specific preventive interventions goals established by the NPP (e.g., reducing sedentary habits, numbers of smokers and salt consumption). Furthermore, due to its large sample size and proven reliability and validity, through analysis on specific subpopulations (such as the present study on CVD prevalence and socio-demographic characteristics) PASSI identifies groups which might be most at risk and need for interventions, providing insight for high-priority issues and relevant gaps in public health. Despite these assets, it has limitations as follow.

*Self-reporting*. As per any interview-based health survey, PASSI data (except for the main demographic characteristics: gender, age, residence) are self-reported; the information released can be somehow biased, generating underestimated or overestimated percentages. Socially undesirable behaviours are prone to underestimation, anyway self-reported data on heart diseases show adequate consistency and sensitivity, and are extremely important in public health [28]. Being ever diagnosed or confirmed any CVD refers to a relevant and rare behaviour and is not affected by misclassification or recall bias [29, 30]. Nevertheless, no information is available on age at diagnosis.

*Unit nonresponse*. Because nonrespondents often differ from interviewees for characteristics under consideration, high nonresponse rates can lead to inaccurate measures of the indicators. There is no general consensus about which value is acceptable, because the alteration of the estimates depends on many factors, such as survey design, study population, reasons for nonresponse, explored variables [31]. However, the PASSI sample is extracted from the LHU lists of residents and this procedure translates to a much wider coverage than similar surveys (e.g., the American BRFSS) so that, as indicated in the "Methods", the final response rate is >80% and, then, goodly assessed [10].

## CONCLUSIONS

This study highlights indeed the potential gain in cardiovascular health profiling individuals as for pres-

ence or absence of CVD as well as for modifiable risk factors.

Our study opens up to further in-depth analyses to explore the direct and indirect impact of the SARS-CoV-2-related crisis on people's health with a particular focus on major cardiovascular risk factors.

Strengthening cardiovascular prevention programs and communication campaigns clearly result to be needed in order to achieve a valuable improvement of the advice delivered by health professionals that, even before the pandemic crisis, was at very low levels. Evidence shows worldwide to what extent governments and individuals are in the position for reducing the health and socioeconomic burden caused by CVD risk. Monitoring health-related behaviours is definitely crucial to plan, implement and evaluate effective preventive policies and interventions.

### *Authors' contributions*

All Authors contributed to the conception or design of the work and to the acquisition, analysis, or interpretation of data for the work. In detail, VS conceptualized and designed the study, and carried out the first analysis. VM further refined the analysis. VS drafted the first version of the manuscript. BC, VP, RG and MM critically revised the manuscript. After sharing intermediate versions of the manuscript, all the Authors gave their final approval and agree to be accountable for all aspects of work ensuring its integrity and accuracy.

### *Acknowledgments*

The Authors are grateful to all the health professionals who are involved in the PASSI surveillance and have contributed to the data collection, as per their role of regional and local coordinators or interviewers. A special thanks goes to the PASSI National Coordinating Group for their competence and commitment.

### *Conflict of interest statement*

All the Authors declare that they have no conflict of interest. This research received no specific grant. The PASSI Surveillance is coordinated by the Italian National Institute of Health and supported by the Italian Ministry of Health/National Centre for Disease Prevention and Control.

### *Members of the PASSI and PASSI d'Argento National Coordinating Group*

Maria Masocco, Valentina Minardi, Benedetta Contoli, Valentina Possenti, Susanna Lana, Centro Nazionale per la Prevenzione delle Malattie e la Promozione della Salute (Cnapps), Istituto Superiore di Sanità, Roma; Nicoletta Bertozzi, Dipartimento di Sanità Pubblica, Ausl Romagna, Cesena; Stefano Campostrini, Dipartimento di Economia, Università Ca' Foscari, Venezia; Giuliano Carrozzi, Dipartimento di Sanità Pubblica, Ausl Modena; Marco Cristofori, Unità Operativa Sorveglianza e Promozione della Salute, Ausl Umbria 2, Orvieto; Angelo D'Argenzio, Igiene, Sicurezza Luoghi di Lavoro e OER, Regione Campania, Napoli; Amalia Maria Carmela De Luca, UOSD Epidemiologia e Sorveglianza di Popolazione, ASP Cosenza; Pirous Fateh-Moghadam, Azienda Provinciale per i Servizi Sanitari, Trento; Mauro Ramigni, Dipartimento di Prevenzione, Aulss 2 Marca Trevigiana, Treviso; Massimo Oddone Trinito, Dipartimento di Prevenzione, Asl Roma 2, Roma; Stefania Vasselli, Ministero della Salute, Roma.

*Received* on 8 July 2021.
*Accepted* on 4 March 2022.

## REFERENCES

1. World Health Organization. Cardiovascular diseases (CVDs). WHO; 2021. Available from: www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds).
2. Eurostat. Causes and occurrence of deaths in the EU. Heart attacks, strokes, cancer: main causes of deaths in the EU. European Commission; 2019. Available from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190716-1.
3. Cortesi PA, Fornari C, Madotto F, Conti S, Naghavi M, Bikbov B, Briant PS, Caso V, Crotti G, Johnson C, Nguyen M, Palmieri L, Perico N, Profili F, Remuzzi G, Roth GA, Traini E, Voller F, Yadgir S, Mazzaglia G, Monasta L, Giampaoli S, Mantovani LG, the GBD 2017 Italy Cardiovascular Diseases Collaborators. Trends in cardiovascular diseases burden and vascular risk factors in Italy: The Global Burden of Disease study 1990-2017. Eur J Prev Cardiol. 2021;28(4):385-96. doi: 10.1177/2047487320949414
4. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases: 2013-2020. WHO; 2013. Available from: http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf.
5. de Mestral C, Stringhini S. Socioeconomic status and cardiovascular disease: an update. Curr Cardiol Rep. 2017;19(11):115. doi: 10.1007/s11886-017-0917-z
6. Manyangu G, Dineen B, Geoghegan R, Flaherty G. Descriptive bibliometric analysis of global publications in lifestyle-based preventive cardiology. Eur J Prev Cardiol. 2019;2047487319854827. doi: 10.1177/2047487319854827
7. Decreto del Presidente del Consiglio dei Ministri 3 marzo 2017. Identificazione dei sistemi di sorveglianza e dei registri di mortalità, di tumori e di altre patologie. Gazzetta Ufficiale Serie Generale n.109, 12 maggio 2017.
8. Decreto del Presidente del Consiglio dei Ministri 12 gennaio 2017. Nuovi livelli essenziali di assistenza. Gazzetta Ufficiale Serie Generale n. 65, 18 marzo 2017, Suppl. Ordinario n. 15 - Prevenzione collettiva e sanità pubblica - Programma F2.
9. Ministero della Salute, Direzione Generale della Prevenzione Sanitaria. Piano Nazionale della Prevenzione 2020-2025. Available from: www.salute.gov.it/imgs/C_17_notizie_5029_0_file.pdf.
10. Baldissera S, Ferrante G, Quarchioni E, Minardi V, Possenti V, Carrozzi G, et al. Field substitution of nonresponders can maintain sample size and structure without altering survey estimates-the experience of the Italian behavioural risk factors surveillance system (PASSI). Ann Epidemiol. 2014;24(4):241-5.
11. American Association for Public Opinion Research.

Standard definitions: final dispositions of case codes and outcome rates for surveys. 9th ed. Available from: www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf.
12. Kroenke K, Spitzer RL, Williams JBW. The patient health questionnaire-2: validity of a two-item depression screener. Med Care. 2003;41(11):1284-92.
13. Barros AJD, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol. 2003;3:21. doi: 10.1186/1471-2288-3-21
14. Istituto Nazionale di Statistica. Popolazione residente in Italia. ISTAT; 2018. Available from: http://dati.istat.it/Index.aspx?DataSetCode=DCIS_POPRES1.
15. Giampaoli S, Palmieri L, Donfrancesco C, Noce CL, Pilotto L, Vannuzzo D. Cardiovascular health in Italy. Ten-year surveillance of cardiovascular diseases and risk factors: Osservatorio Epidemiologico Cardiovascolare/Health Examination Survey 1998-2012. Eur J Prev Cardiol. 2015;22(Suppl. 2):9-37. doi: 10.1177/2047487315589011
16. Marmot M. Society and health of migrants. Eur J Epidemiol. 2016;31(7):639-41.
17. Banks E, Josh G, Kord RJ, Stavreski B, Soga K, Egger S, et al. Tobacco smoking and risk of 36 cardiovascular disease subtypes: fatal and non-fatal outcomes in a large prospective Australian study. BMC Medicine. 2019;17:128. doi: 10.1186/s12916-019-1351-4
18. Holmes MV, Dale CE, Zuccolo L, Silverwood RJ, Guo Y, Ye Z et al. Association between alcohol and cardiovascular disease: Mendelian randomisation analysis based on individual participant data. BMJ. 2014;349:g4164.
19. Wijndaele K, Brage S, Besson H, et al. Television viewing and incident cardiovascular disease: prospective associations and mediation analysis in the EPIC Norfolk Study. PLoS One. 2011;6(5):e20058.
20. Chomistek AK, Manson JE, Stefanick ML, et al. Relationship of sedentary behavior and physical activity to incident cardiovascular disease: results from the Women's Health Initiative. J Am Coll Cardiol. 2013;61:2346-54.
21. Gray L, Lee IM, Sesso HD, Batty GD. Blood pressure in early adulthood, hypertension in middle age, and future cardiovascular disease mortality: HAHS (Harvard Alumni Health Study). J Am Coll Cardiol. 2011;58:2396-403.
22. Yusuf S, Hawken S, Ôunpuu S. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. Lancet. 2004;364:937-52.
23. Kotseva K, Wood D, De Bacquer D. EUROASPIRE IV: A European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from 24 European countries. Eur J Prevent Cardiol. 2016;23:636-48.
24. Tiffe T, Morbach C, Malsch C, Gelbrich G, Wahl V, Wagner M, et al. Physicians' lifestyle advice on primary and secondary cardiovascular disease prevention in Germany: A comparison between the STAAB cohort study and the German subset of EUROASPIRE IV. Eur J Prev Cardiol. 2019;2047487319838218. doi: 10.1177/2047487319838218
25. Nunan D. Doctors should be able to prescribe exercise like a drug. BMJ 2016;353:i2468
26. Bansal M. Cardiovascular disease and COVID-19. Diabetes Metab Syndr. 2020;14(3):247-50. doi:10.1016/j.dsx.2020.03.013
27. De Rubeis V, Lee J, Anwer MS, et al. Impact of disasters, including pandemics, on cardiometabolic outcomes across the life-course: a systematic review. BMJ Open. 2021;11:e047152. doi:10.1136/bmjopen-2020-047152.
28. Nelson DE, Holtzman D, Bolen J, Stanwyck CA, Mack KA. Reliability and validity of measures from the Behavioral Risk Factor Surveillance System (BRFSS). Soz Praventiv med. 2001;46:S3-42.
29. Misirli G, Bamia C, Dilis V, Benetou V, Zilis D, Trichopoulou A. Validation of self-reported incident cardiovascular disease events in the Greek EPIC cohort study. Ital J Public Health 2012;9(3). doi: 10.2427/7538.
30. Eliassen B-M, Melhus M, Tell GS, Borch KB, Braaten T, Broderstad AR, et al. Validity of self-reported myocardial infarction and stroke in regions with Sami and Norwegian populations: the SAMINOR 1 Survey and the CVDNOR project. BMJ Open. 2006;(11):e012717.
31. Groves RM. Nonresponse rates and nonresponse bias in household surveys. Public Opin Q. 2006;70(5):646-75.