

Cardiovascular Screening: Results and Analysis of Behavioural Risk Factors in AULSS5 Polesana

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ABSTRACT

Background: Cardiovascular diseases (CVDs) represent the leading cause of morbidity and mortality worldwide, in Europe, and in Italy. Their onset can be prevented through a healthy lifestyle, including a balanced diet, regular physical activity, and abstention from smoking and alcohol consumption. The proactive cardiovascular screening program "Cardio50", provided for by the 2020-2025 Regional Prevention Plan of the Veneto Region, is positioned as a primary and secondary prevention intervention aimed at the early identification of modifiable risk factors in an apparently healthy population.

Objective: The study analysed the results of the "Cardio50" screening program conducted by the Prevention Department of AULSS 5 Polesana during the 2024-2025 two-year period on the cohort of subjects born in 1974-1975. Results were compared with data from the PASSI surveillance system relating to the same territory.

Materials and Methods: During the session of the cardiovascular screening, participants' lifestyle habits are investigated and anthropometric, blood pressure, and blood chemistry parameters are recorded, on the basis of which the software assigns a specific risk class (A, B1, B2, C, C1, D). Subjects in Class B2 are recalled for a six-month follow-up.

Results: Out of 5481 potential participants, 2107 subjects (38.4%) took part, including 1109 women and 998 men. The distribution of risk classes showed a clear predominance of Class B2 (44.8%), followed by Class C (25.2%); overall, 85.2% of subjects required targeted interventions to address their risk factors. Six-month follow-up participation among subjects in Class B2 was 13.6%. Of the participants, 24.1% were smokers, 64.1% led a physically active lifestyle, 52.4% presented excess body weight and 12% consumed alcohol in a manner defined as higher-risk for health.

Discussion: The clear predominance of subjects in Class B2, nearly one in two participants, highlights how a substantial proportion of the population exhibits at-risk behaviours despite the absence of overt clinical abnormalities, identifying a priority target for primary prevention. The low follow-up return rate represents a significant critical issue, as the sole initial detection of risk factors does not guarantee a genuine public health benefit without continuity of the preventive pathway. Comparison with PASSI showed consistency for smoking and excess body weight, a modest difference in physical activity levels and a discrepancy regarding alcohol consumption.

Conclusions: The study confirms the usefulness of the "Cardio50" program in the early detection of modifiable cardiovascular risk factors, but highlights the need to strengthen

patient retention strategies during follow-up, including through greater involvement of general practitioners and local healthcare networks, in order to transform screening into a genuine long-term cardiovascular prevention pathway through integrated care.

INTRODUCTION

Cardiovascular diseases (CVD) nowadays constitute one of the leading public health problems worldwide, being responsible for a high proportion of morbidity and mortality. According to World Health Organization (WHO) data, approximately 19.8 million deaths were attributable to CVD in 2022, corresponding to about 32% of global all-cause mortality. Of particular relevance is the burden that these conditions place on premature mortality: in 2021, among the 18 million deaths occurring before age 70 due to noncommunicable diseases, at least 38% were attributable to cardiovascular disease [1]. In 2022, CVD caused approximately 1.68 million deaths in Europe, equal to 32.7% of all deaths recorded on the continent [2]. In Italy, the most recent ISTAT report (2022) shows that these diseases are responsible for roughly one-third of all deaths, 222,717 (30.8%), with a higher incidence among women, 125,492 (33.4%), compared with men, 97,225 (28.1%) [3]. In the Veneto region in 2024, 15,018 deaths (30.1%) were recorded due to diseases of the circulatory system, with a higher incidence among women (8,300) than men (6,718). In the AULSS5 Polesana health territory, over the period 2020–2024, 2,413 CVD-attributable deaths were recorded among men, equal to 32.5% of all deaths, compared with 3,283 among women, equal to 38.7% of the total [4].

Recent scientific evidence has reinforced the central role of a healthy lifestyle across the entire lifespan in the primary prevention of cardiovascular disease, through adherence to a healthy dietary pattern, engagement in regular physical activity, and complete tobacco abstinence. Alongside these pillars, control of alcohol consumption is also recognized as one of the major modifiable risk factors for atherosclerotic cardiovascular disease, with intake recommended to be limited to a maximum of 100 g per week, a benefit that is even greater among nondrinkers. Completing this picture, the most recent international guidelines also recommend body weight control, together with the management of psychosocial stress, and the promotion of healthy sleep habits, as further key components of early lifestyle intervention [5–8]. Several studies have also shown that preventive interventions lead not only to improved health outcomes in patients, but also to a significant reduction in healthcare costs [9–11], confirming the validity of cardiovascular screening programs as a public health strategy.

Analysis of provincial-level data on residents of AULSS 5 Polesana for the two-year period 2023–2024, processed through the PASSI surveillance system (Progress of Authorities for Healthcare in Italy), estimates that 49% of adults aged 18–69 are overweight. This condition becomes more frequent with increasing age (56% among 50–69-year-olds versus 30% among 18–34-year-olds) and among men (56% versus 41% among women). According to the definition based on current WHO standards, 57% of the population is physically active, while a sedentary lifestyle is reported more often among women (19% versus 12% among men) and among 35–49-year-olds (20% versus 9% among 18–34-year-olds). Regarding smoking habits, the majority of adults do not smoke (53%) or have quit smoking (26%), but about 1 in 5 is a current smoker (22%). The average number of cigarettes smoked per day is 10.5. Smoking is less common among women (20% versus

24% among men) and among 50–69-year-olds (19%), while the age group with the highest smoking prevalence is 18–24-year-olds (31%). Among smokers, 17% are heavy smokers (20 or more cigarettes per day), while 4% are occasional smokers (fewer than one cigarette per day). With regard to alcohol consumption, 34% of adults aged 18–69 report not consuming alcoholic beverages, but more than 1 in 4 (27%) consumes alcohol in a manner defined as higher-risk for health, whether by quantity or pattern of intake; this higher-risk pattern is more frequent among men (29% versus 26% among women).

The Veneto Region's Regional Prevention Plan (PRP) 2020–2025, translating the objectives of the 2020–2025 National Prevention Plan (PNP), confirms the “Cardio50” cardiovascular screening program (PL11), already present in the previous PRP. The aim of the campaign is the early detection of the main cardiovascular risk factors and the promotion of lifestyle changes in an apparently healthy population, in order to reduce CVD morbidity and mortality [12].

The specific objectives identified by the program are numerous, namely:

- to assess cardiovascular risk in the target population;
- to identify subjects with inadequate lifestyle habits (smoking, alcohol use, poor diet, sedentary behaviour);
- to identify “newly hypertensive,” “newly hyperglycemic,” and “newly hypercholesterolemic” subjects;
- to establish an integrated model of care across the different macro-structures involved (Department of Prevention, District – General Practitioner, Hospital) to counter modifiable risk factors;
- to promote individual empowerment regarding cardiovascular risk factors, fostering awareness and the capacity to act on one's own health;
- to evaluate and monitor the entire process with a view to optimizing the most appropriate organizational arrangements for the proposed pathway.

The present study aims to analyse the results of the “Cardio50” cardiovascular screening program conducted by AULSS5 Polesana during the 2024–2025 two-year period, focusing on the cohort of subjects born in 1974–1975. The results are further compared with data from the PASSI surveillance system.

MATERIALS AND METHODS

The target population of the “Cardio50” cardiovascular screening program consists of men and women aged 50–51 residing within AULSS 5, in accordance with the regional protocol for cardiovascular prevention [13]. This age group was selected because it represents a particular stage of life characterized by greater susceptibility to cardiovascular disease, combined with greater receptiveness and openness to change. This is also borne out by projects preceding the current “Cardio50” program, in which this cohort was found to be in particular need of preventive intervention. Selecting this age group also makes it possible to plan and implement a follow-up phase for the identified population, making the screening sustainable from an organizational standpoint as well. The population not eligible for the program consists of subjects already affected by conditions or clinical diseases already covered by the National Health Service through targeted exemptions.

The “Cardio50” procedure is structured into several operational phases to ensure the

effectiveness of the screening. During enrollment, following identification of eligible participants, a paper invitation to the cardiovascular screening is sent to the target population. Subjects self-book their appointment through the “MyPrenota” digital portal, accessible from the company webpage dedicated to the “Cardio50” screening program. If a subject fails to attend the appointment, a reminder is sent inviting them to arrange a new appointment by contacting the Screening Organizational Center. All operational phases are managed through a dedicated information system (Regional Cardiovascular Screening Software).

The screening session takes place in an appropriately equipped venue within the Department of Prevention and is carried out mainly by nurses and health assistants who have been trained to ensure effective, personalized interventions. The required materials include workstations with PC and printer, cholesterol and blood-glucose meters, lancets, test strips, quality-control solutions, disinfectants, cotton, adhesive bandages, waste-disposal materials, disposable gloves, a tape measure, a sphygmomanometer (with standard and bariatric cuffs), a scale, a stadiometer, reference material for the operator, informational material for users, and paper copies of the questionnaires.

At the start of the session, the health operator welcomes the invited person and briefly explains the program’s objectives. The operator then accesses the Cardiovascular Screening software, completes the record with any missing personal data, and obtains consent to the processing of health data in accordance with current privacy legislation. The operator reviews any recent blood test results (performed within the last six months) regarding total cholesterol, HDL/LDL, and blood glucose, and enters them into the data-collection form. At this point the lifestyle assessment begins: using the software, the operator completes the questionnaire and conducts a brief motivational intervention on lifestyle habits. The aspects investigated in depth through the standardized questionnaire built into the software application include:

- general characteristics of the participant (personal data, etc.);
- smoking habits (tobacco and heated electronic cigarettes);
- alcohol consumption habits (frequency and quantity consumed in alcohol units);
- level of physical activity, categorized according to WHO recommendations;
- fruit and vegetable consumption, categorized according to healthy dietary guidelines;
- general dietary habits, including consumption of red meat and sausages, white meat, and fish;
- alt intake, categorized according to WHO recommendations.

During the session, three elements are essential: raising the issue (asking), communicating the risk (giving feedback), and providing information on the risks associated with continuing the risk behaviour (e.g., alcohol consumption), on the benefits of reducing or abstaining from it, and a series of brief, clear, specific, and personalized recommendations to facilitate change. The information collected through the questionnaire contributes to the overall assessment of the individual’s cardiovascular risk.

Following the lifestyle assessment phase, a number of parameters are measured, including blood pressure, blood chemistry parameters (in the absence of recent laboratory tests), and anthropometric measurements, with the operator simultaneously explaining their meaning and any associated cardiovascular risks, specifically:

- Blood pressure (BP): measured with the subject seated and relaxed, using an OMRON

M3 automatic digital sphygmomanometer.

Two measurements are taken, one at the beginning and one at the end of the session. If the first measurement shows elevated values (SYS ≥ 140 mmHg and/or DIA ≥ 90 mmHg), a second measurement is taken; if values remain elevated, the highest values are recorded in the report. If values are above normal, a “Blood Pressure Diary” is provided for monitoring and possible follow-up by the subject’s general practitioner (GP). In urgent situations (systolic BP > 220 mmHg or diastolic BP > 130 mmHg), the person is referred to the Emergency Department.

- Blood glucose: if the person has no recent test results (within the last six months), a fingerstick glucose test is performed using an Xpress-i glucometer. Three types of assessment are provided: fasting glucose (normal up to 109 mg/dL), random glucose (normal up to 109 mg/dL if more than 3 hours since the last meal), and postprandial glucose (normal up to 139 mg/dL if less than 3 hours since the last meal).
- Cholesterol: a fingerstick test is performed using an Accutrend Plus meter. The measurement can be taken at any time of day, and values below 240 mg/dL are considered within the normal range.
- Weight and height: weight is measured with the person in light clothing and without shoes. For height, the subject must adopt a specific position (shoulders against the stadiometer, feet at a right angle, heels together, etc.). The software automatically calculates Body Mass Index (BMI), with reference categories for underweight (≤ 18.4), normal weight (18.5–24.9), overweight (25–29.9), and obesity (≥ 30).
- Waist circumference: measured with a tape positioned parallel to the floor, around the bare abdomen. The measurement is taken at the end of an exhalation, with the subject relaxed. Normal values are < 80 cm for women and < 94 cm for men.

The data collected from the questionnaire and the measurements are processed by the software, which classifies subjects into different risk classes. At the end of the session, the health operator provides the subject with a specific report corresponding to their assigned risk class and the relevant informational material. The risk classes are defined as follows:

- Class A: subjects with anthropometric, laboratory, and blood-pressure parameters within normal range and a healthy lifestyle belong to this class. These subjects do not require follow-up.
- Class B1: subjects are classified as B1 when laboratory parameters and blood pressure are within normal range, but with only one behavioural risk factor among the following: fruit and vegetable consumption of 3 or 4 servings per day, BMI between 25 and 27, or waist circumference between 80–88 cm for women or 94–102 cm for men. The health operator recommends group programs on healthy eating and provides informational material, but as with Class A, these subjects are not recalled for follow-up.
- Class B2: subjects belong to Class B2 when laboratory parameters and blood pressure are within normal range, but they present a single behavioural risk factor among: smoking habit, light or absent physical activity, fruit and vegetable consumption ≤ 2 servings per day, intake of at least 3 alcohol units per day for men or at least 2 for women, BMI ≥ 27 , or waist circumference > 88 cm in women or > 102 cm in men. For the proposed nutritional pathways, direct case management is possible by entering the subject into a shared platform with the SIAN (Food Hygiene and Nutrition Service) and Clinical Nutrition services, which enroll the user in one of the two services based on the subject’s BMI. Informational brochures are also provided: one for smokers and two for those who

do not meet adequate physical activity levels, indicating fee-based supervised exercise programs with reduced costs thanks to an agreement between the Health Authority and UISP (Italian Sports for All Union).

- Class C: subjects are classified as C when laboratory parameters and blood pressure are outside normal range and at least one behavioural risk factor from those listed for Class B2 is present. Abnormal parameters include: SYS BP ≥ 140 mmHg and/or DIA BP ≥ 90 mmHg; blood glucose ≥ 110 mg/dL (random or fasting) or postprandial glucose ≥ 140 mg/dL; cholesterol ≥ 240 mg/dL. These subjects are not recalled further but are advised to consult their general practitioner to discuss the report.

- Class C1: subjects belong to Class C1 when laboratory parameters and blood pressure are outside normal range and no behavioural risk factors are present. As with Class C, these subjects are not recalled further but are advised to consult their general practitioner.

- Class D: subjects who are not eligible or are excluded because they are already under treatment or affected by relevant conditions are classified as D. If a subject meeting exclusion criteria nonetheless attends the appointment, they are still assessed and subsequently classified as excluded.

Subjects falling within Class B2 are offered a pathway aimed at improving their condition and are recalled for follow-up after six months, receiving a new invitation with self-booking to assess whether the goals set at the first appointment have been achieved. The questionnaire completed during the follow-up session is recorded as a new report. If no positive change in the subject's lifestyle is observed, the health operator again offers the existing initiatives concerning diet, physical activity, smoking, and alcohol. This approach makes it possible to tailor the intervention to the individual characteristics of the subject, increasing the likelihood of success of the cardiovascular prevention pathway. At the time of the initial screening, tacit informed consent for the processing of personal data was obtained. The study was conducted in accordance with the World Medical Association's Declaration of Helsinki; it did not involve experiments on human subjects, nor the use of human biological samples or identifiable personal data.

RESULTS

In 2024-2025, the Prevention Department of AULSS5 Polesana invited subjects born in the 1974-1975 birth cohort to participate in the "Cardio50" Screening Program, with a total of 5481 potential participants. A total of 2107 subjects (38.4%) took part, including 1109 women and 998 men. Analysis of the distribution of risk classes (Table I) reveals a predominance of class B2, which includes nearly 50% of subjects, followed by a significant proportion in classes C and C1. Screening sessions were evenly distributed across the territory, being held in Rovigo, Adria, and Trecenta.

Table I – Distribution of Risk Classes

Risk Class	Number of Subjects	Percentage
Class A	95	4,5%
Class B1	228	10,8%
Class B2	944	44,8%
Class C	590	25,2%
Class C1	92	4,4%
Class D	218	10,3%
TOTAL	2.107	100%

Furthermore, as shown in Table II, fewer than 14% of subjects classified in risk class B2 returned for follow-up after six months.

Table II – Six-month follow-up participation (1974–1975 Cohort)

Group considered	Number of Subjects	Percentage
Subjects who attended follow-up	129	13,6%
Subjects in Class B2 (recalled for follow up)	944	100%

Analysis of the questionnaires provided an in-depth overview of lifestyle habits and behaviours related to the main risk factors for cardiovascular disease.

Table III – Distribution of subjects by smoking status

Smoking Status	Number of Subjects	Percentage
Smokers	508	24,1%
Never smoked	1265	60%
Former smokers	334	15,9%
Total	2.107	100%

Table IV – Alcoholic beverage consumption frequency

Alcohol Consumption	Number of Subjects	Percentage
Daily	758	36%
Weekly	1000	47,5%
Monthly	348	16,5%
Total	2.107	100%

Table V – Levels of physical activity

Physical Activity Level	Number of Subjects	Percentage
Physically Active	1350	64,1%
Physically Inactive	757	35,9%
Total	2.107	100%

Table VI – Fruit and vegetable consumption

Fruit and Vegetable Consumption	Number of Subjects	Percentage
Daily	1973	93,6%
Weekly	129	6,1%
Monthly	5	0,2%
Total	2.107	100%

Table VII – Body mass index categories

BMI Category	Number of Subjects	Percentage
Underweight	37	1,8%
Normal Weight	966	45,8%
Overweight	375	17,8%
Obese	729	34,6%
Total	2.107	100%

DISCUSSION

The effectiveness of a proactive screening program is measured not only by its ability to reach the target population at the outset, but above all by the sustainability of the preventive pathway over time. The 13.6% follow-up participation rate among subjects in risk Class B2 therefore represents an element that must be addressed in order to improve adherence. Analysis of the distribution of risk classes showed that Class B2 accounted for the majority of the sample (nearly one in two participants). This finding is particularly significant from a public health perspective: these are subjects who, despite not yet having developed overt clinical abnormalities, exhibit behaviours that expose them to a high risk of developing chronic conditions in the medium to long term. Furthermore, nearly 30% of participants were classified as C or C1, already presenting a compromised clinical situation or one warranting immediate diagnostic/therapeutic investigation, confirming the usefulness of screening in uncovering previously undiagnosed conditions. Overall, 85.2% of subjects required targeted interventions to improve their risk factors, confirming that initial detection alone is not sufficient to guarantee a genuine public health benefit unless accompanied by continuity of the preventive pathway.

Analysis of the sample's lifestyle habits showed a smoking prevalence of 24.1%, with a combined proportion of current and former smokers close to 40%; the remaining 60% reported never having used tobacco. These values are consistent with those reported by the PASSI surveillance system (22% current smokers). Regarding alcohol consumption, 36% of respondents reported daily intake of alcoholic beverages; 47.5% reported weekly consumption, while 16.5% consumed alcohol on a monthly basis. In this cohort, 12% of the sample engaged in consumption considered higher-risk according to WHO recommendations, a figure showing a notable discrepancy with the PASSI surveillance system, in which 27% of subjects fell into this category. Regarding physical activity, 64.1% of participants led an active lifestyle, a modestly higher proportion than the 57% reported by PASSI surveillance. With respect to weight status, 17.8% of the sample had a body mass index between 25 and 30 (overweight) and 34.6% had a BMI above 30 (obesity); the overall prevalence of excess body weight (52.4%) was consistent with the PASSI figure, in which this condition affected 49% of individuals. In terms of dietary habits, 93.6% of participants consumed fruit and vegetables daily, although, as detected by the questionnaire, only 6.4% reached the recommended five daily servings. Salt intake, according to questionnaire data, was predominantly at low (54.4%) and medium (41.7%) levels. Overall, comparison with the PASSI surveillance system shows substantial consistency in data on smoking and excess body weight, a modest difference in physical activity levels, and a notable discrepancy with respect to risky alcohol consumption.

CONCLUSIONS

Systematic analysis of the data collected through the "Cardio50" program in AULSS 5 Polesana allows some fundamental reflections to be drawn on the value of territorial cardiovascular prevention. The clear predominance of subjects in Class B2, nearly one in two participants, underscores how the true battleground for public health is not only the management of diagnosed disease, but the proactive modification of everyday habits before organic damage manifests, identifying this population as a priority target for primary prevention. However, the results highlight a discrepancy between initial participation and continuity of care, as reflected in the six-month follow-up return rate. It thus clearly emerges that the effectiveness of screening cannot be limited to a single diagnostic encounter, but must necessarily evolve toward an integrated care model involving closer engagement of general practitioners and the use of local support networks.

In conclusion, the "Cardio50" project confirms itself as an indispensable safeguard for reducing the future burden of cardiovascular disease. The success of preventive interventions will increasingly depend on the healthcare system's ability to transform them into a process of individual empowerment, making citizens informed protagonists of their own health through increasingly personalized and accessible motivational counselling, thereby establishing the "Cardio50" program as a genuine long-term cardiovascular prevention pathway.

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