

Perceived Risk of Cardiovascular Diseases in the Italian population: Insights from the INNOPREV trial

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Abstract

Objective

Cardiovascular disease (CVDs) is the leading cause of death globally. This study, within the Italian INNOPREV trial, explored cardiovascular risk perception in adults aged 40–69 years old at moderate-to-high risk of CVDs and its association with socio-demographic, behavioural, and clinical characteristics.

Methods

Cardiovascular risk perception was measured using the Health Beliefs Related to Cardiovascular Disease Scale (HBCVD; 25 items; four subscales: susceptibility, severity, benefits, barriers). Mean HBCVD scores were compared across socio-demographic variables (sex, age, marital status, education level, employment status) and risk factors (smoking status, BMI, family history of cardiovascular conditions, SCORE2, and Life Essential, 8 score–LE8). Non-parametric tests (Wilcoxon or Kruskal–Wallis, as appropriate) were used. Results were summarized using forest plots, reporting mean scores with 95% confidence intervals and p-values.

Results

A total of 1,019 participants (52.11% males; mean age: 55 years old), and 988 questionnaires were successfully collected and analyzed. The mean overall HBCVD score was 62.30 ± 6.15 (out of 100). Employment status was the only sociodemographic variable associated with HBCVD ($p = 0.035$), with higher scores among homemakers/unemployed and lower scores among retired participants. HBCVD was also associated with BMI class ($p = 0.003$), family history of hypercholesterolaemia ($p = 0.023$), and LE8 score ($p = 0.006$). Scores increased with higher BMI in people with a family history of hypercholesterolaemia, and with poorer cardiovascular health based on LE8 score.

Conclusions

Risk perception of CVD was overall moderate and varied by socio-demographic characteristics and risk factors. These findings might support the development of tailored preventive strategies to enhance risk awareness and promote healthy behaviours.

Introduction

Cardiovascular diseases (CVDs) remain the leading cause of death and disability across Europe, accounting over 1.68 million deaths in 2022 or 32.7% of all deaths in the WHO European Region [1]. In Italy, despite a significant decline since 1990 to nowadays in age-standardised prevalence (-12.7%), mortality rate (-53.8%), and disability-adjusted life years rate (-55.5%), CVDs continue to represent the

primary cause of death, being responsible for 30.8% of overall mortality [3]. The burden of CVDs remains high, particularly due to population aging [4] and the persistence of modifiable risk factors, such as hypertension, unhealthy diet, obesity, and dyslipidaemia [5–7]. In addition to direct healthcare costs, CVDs are also associated with significant indirect costs due to decreased productivity as well as reduced quality of life [8].

More than 80% of the cardiovascular burden is attributable to known modifiable risk factors [2], many of which are unevenly distributed across socioeconomic groups [9]. Preventive strategies, including lifestyle changes (e.g., diet, physical activity, smoking cessation) [10] and medical interventions for at-risk individuals, have proven effective in reducing CVD incidence [11]. However, individuals' health-related behaviours are not driven by clinical risk alone, but are influenced by their beliefs and perceptions about risk, illness, and prevention [12].

Risk perception is often assessed to better understand people's thoughts about diseases and their attitudes toward preventive health behaviours. However, risk perception is a highly complex concept and the relationship between risk perception and behaviour change can be inconsistent [13]. Several factors may influence one's perception of risk, including individual characteristics, perceptions of general health, knowledge of the illness or disease, risk factor status, family history of disease, perceived control, personal experience, and media exposure [13]. Individual risk perceptions may also vary based on current behaviours and behavioural intentions [14]. A bidirectional relationship exists between risk perception and behaviour change over time, such that individuals who engage in risky behaviours may perceive a higher risk, and risk perception may influence individuals to make behaviour changes, but once the protective behaviour is adopted, perception of risk is likely to decrease [15]. Consequently, underestimations of perceived risk can hinder the decision-making, underscoring the need for continuous assessment and reinforcement [15].

To explain and predict health behaviours, several models have been proposed. One of them is the Health Belief Model (HBM), a socio-psychological model that attempts to explain and predict health behaviours in terms of certain belief patterns and by focusing on the attitudes and beliefs of individuals [16]. Developed in the 1950s as part of an effort by social psychologists in the United States Public Health Service to explain the lack of public participation in health screening and prevention programmes, it has been adapted to explore a variety of long and short-term health behaviours, including cardiovascular risk behaviours [17]. The HBM addresses the individual's perceptions of the threat posed by a health problem (susceptibility, severity), the benefits of avoiding the threat, and factors influencing the decision to act (barriers, cues to action, and self-efficacy). It states that perceptions of general health values, specific health beliefs related to the health problem and recommended health actions influence the likelihood of taking recommended health actions.

This study aimed to assess how Italian individuals at moderate-to-high risk of CVDs perceive their risk using the Health Belief related to CVD (HBCVD) scale, and to explore how these perceptions vary according to socio-demographic characteristics, behavioural factors, and clinical characteristics.

Methods

1.1. Inclusion and exclusion criteria

The study embeds in the INNOPREV trial, which is a four-arm randomized controlled trial conducted in Italy [18]. This multicenter prospective study was conducted among individuals aged 40 to 69 years old without established CVDs, diabetes mellitus, or familial hypercholesterolemia. Participants were selected based on being at moderate-to-high cardiovascular risk, defined as a 10-year risk of cardiovascular events between 2.5% and 10%, as estimated using the SCORE2 risk charts [19].

1.2. Study design and sample recruitment

The study was carried out in three centres: Rome (Central Italy), Catania, and Palermo (Southern Italy). Recruitment was conducted in various healthcare settings, depending on the location: primary care ambulatories in Rome, Occupational Health Physicians and specialist physicians in Catania, and a vaccination centre in Palermo [18].

All eligible individuals accessing the identified recruitment settings were invited to participate and received detailed information both orally and through an informative leaflet. Those who gave consent were formally enrolled and received the planned interventions. The recruitment phase lasted 8 months and has been completed. Participants are being followed for a total period of 12 months.

Upon enrolment (T0), participants underwent a comprehensive baseline assessment, including cardiovascular evaluation and structured questionnaires.

1.3. Data collection instrument and process

Data collection at T0 was conducted through structured interviews and standardized clinical assessments and all data were recorded and managed electronically within REDCap [20]. The baseline data collection process included also a combination of validated self-administered questionnaires, including the HBCVD 25-item scale [17]. The latter was divided into four subscales: *perceived susceptibility* (5 items), *perceived severity* (5 items), *perceived benefits* (6 items), and *perceived barriers* (9 items). A four-point Likert scale (from 1 - Strongly Disagree to 4 - Strongly Agree) was used to collect information. Higher scores on the susceptibility dimension reflect a stronger perception of personal risk of developing CVD. Elevated severity scores indicate that participants view the condition as more serious. The benefit subscale captures the extent to which individuals believe in the efficacy of preventive behaviours, while the barriers subscale measures perceived obstacles to adopt such behaviours, with higher scores indicating greater perceived difficulty.

Socio-demographic data (e.g., age, sex, education, area of residence) and lifestyle behaviours were evaluated using the Life Essential 8 score, (LE8) score [21], a validated tool developed by the American Heart Association to categorize individuals into favourable, intermediate, or unfavourable cardiovascular lifestyle profiles [22]. This tool incorporates eight domains: physical activity, Body Mass Index (BMI),

blood pressure, diet, nicotine exposure, cholesterol levels, blood glucose, and sleep health. Each component is scored on a 0–100 scale, and scores are averaged (unweighted) to generate an overall cardiovascular health score, also ranging from 0 to 100. Higher LE8 scores are associated with a substantially lower risk of CVD incidence [23].

1.4. Data management and statistical analysis

Data cleaning procedures were implemented to oversee missing values, which were excluded from the relevant analyses. Normality of continuous variables was evaluated using the Shapiro–Wilk test; the distributions were bell-shaped with moderate skewness.

Responses to the HBCVD scale were managed as follows. Each of the four subscales (*susceptibility, severity, benefits, barriers*) was scored by summing the responses to the items belonging to that specific subscale. The overall HBCVD score was calculated by summing the scores of all items included in the questionnaire, with higher scores indicating a higher level of cardiovascular risk perception. Participants were grouped into three age classes (40–49, 50–59, 60–69 years old) based on their reported age. BMI was categorized into three groups: <25 kg/m² (underweight/normal), 25–29.9 kg/m² (overweight), and ≥ 30 kg/m² (obesity) [24–26]. Family history of CVD and stroke was combined into a single variable. Participants were classified as “At least one yes” if they reported a positive family history for either CVD or stroke, “No” if they reported no family history for both conditions, and “Don’t know” otherwise.

SCORE2 was summarized as mean ± standard deviation (SD). In addition, SCORE2 was categorized into tertile-based ranges using the 33rd and 66th percentile cut-offs (3.1 and 5.2): lower range (Score2 ≤ 3.1), mid range (3.1 < Score2 ≤ 5.2), and above range (Score2 > 5.2).

Based on LE8 scores, cardiovascular health (CVH) was classified into three categories according to established thresholds [21]: low (0–49), moderate (50–79), and high (80–100).

The statistical analyses aimed to evaluate associations between the different independent variables and the HBCVD score overall and for each HBCVD subscale. Non-parametric tests were used, specifically the Wilcoxon rank-sum test (for comparing two groups) and Kruskal-Wallis test (for comparing three or more groups). Responses marked as ‘Don’t know’ were excluded from these analyses to ensure the accuracy and reliability of the results.

All statistical analyses were performed using RStudio (version 2025). The level of statistical significance was set at $p < 0.05$.

Results

Of the 1,019 participants enrolled (52.10% male), nearly half were aged 50–59 years old (46.71%), while 22.08% were 40–49 and 31.21% were 60–69 (Table 1). Most were married or partnered (71.84%), with 9.52% never married, and 16.58% widowed, divorced or separated.

Table 1
Baseline Demographics and health and family history.

Variable	Category	Females n. (%)	Males n. (%)	Total n. (%)
Sex	Male / Female	488 (47.89%)	531 (52.11%)	1019 (100%)
Age (years old)	40–49	85 (8.34%)	140 (13.74%)	225 (22.08%)
	50–59	228 (22.37%)	248 (24.34%)	476 (46.71%)
	60–69	175 (17.17%)	143 (14.03%)	318 (31.21%)
Marital status	Never married	56 (5.50%)	41 (4.02%)	97 (9.52%)
	Married or Partnered	319 (31.31%)	413 (40.53%)	732 (71.84%)
	Widowed/ Divorced/ Separated	102 (10.01%)	67 (6.58%)	169 (16.58%)
	Missing	11 (1.08%)	10 (0.98%)	21 (2.06%)
Education level	Elementary/ Intermediate	48 (4.71%)	35 (3.43%)	83 (8.15%)
	High School	196 (19.23%)	201 (19.73%)	397 (38.96%)
	College Degree or Postgraduate	235 (23.06%)	284 (27.87%)	519 (50.93%)
	Missing	9 (0.88%)	11 (1.08%)	20 (1.96%)
Occupational status	Employed	337 (33.07%)	421 (41.32%)	758 (74.39%)
	Homemaker/ Unemployed	71 (6.97%)	11 (1.08%)	82 (8.05%)
	Retired	44 (4.32%)	58 (5.69%)	102 (10.01%)
	Other	25 (2.45%)	27 (2.65%)	52 (5.10%)
	Missing	11 (1.08%)	14 (1.37%)	25 (2.45%)
Smoking	Never smoked	269 (26.40%)	275 (26.99%)	544 (53.39%)
	Ex-smoker	113 (11.09%)	153 (15.01%)	266 (26.10%)

Variable	Category	Females n. (%)	Males n. (%)	Total n. (%)
	Current smoker	101 (9.91%)	96 (9.42%)	197 (19.33%)
	Missing	5 (0.49%)	7 (0.69%)	12 (1.18%)
BMI	Underweight/Normal	296 (29.05%)	179 (17.57%)	475 (46.61%)
	Overweight	135 (13.25%)	267 (26.20%)	402 (39.45%)
	Obese	57 (5.59%)	84 (8.24%)	141 (13.84%)
	Missing	0 (0.0%)	1 (0.10%)	1 (0.10%)
Family history: CVD or STROKE	At least one yes	205 (20.12%)	183 (17.96%)	388 (38.08%)
	No	271 (26.59%)	338 (33.17%)	609 (59.76%)
	Don't know	8 (0.79%)	6 (0.59%)	14 (1.37%)
	Missing	4 (0.39%)	4 (0.39%)	8 (0.79%)
Family history: High cholesterol	Yes	240 (23.55%)	210 (20.61%)	450 (44.16%)
	No	225 (22.08%)	282 (27.67%)	507 (49.75%)
	Don't know	19 (1.86%)	33 (3.24%)	52 (5.10%)
	Missing	4 (0.39%)	6 (0.59%)	10 (0.98%)
Family history: Diabetes	Yes	141 (13.84%)	150 (14.72%)	291 (28.56%)
	No	333 (32.68%)	357 (35.03%)	690 (67.71%)
	Don't know	8 (0.79%)	16 (1.57%)	24 (2.36%)
	Missing	6 (0.59%)	8 (0.79%)	14 (1.37%)
Family history: Hypertension (parents)	Yes	283 (27.7%)	272 (26.69%)	555 (54.47%)
	No	182 (17.86%)	225 (22.08%)	407 (39.94%)
	Don't know	18 (1.77%)	27 (2.65%)	45 (4.42%)

Variable	Category	Females n. (%)	Males n. (%)	Total n. (%)
	Missing	5 (0.49%)	7 (0.69%)	12 (1.18%)
		Females	Males	Total
SCORE2	(mean $\pm$ sd)	3.91 ($\pm$ 1.67)	5.37 ($\pm$ 2.28)	4.67 ($\pm$ 2.14)
SCORE2 Cluster n. (%)	Lower range (Score2 $\leq$ 3.1)	224 (21.98%)	112 (10.99%)	336 (32.97%)
	Mid-range (3.1 < Score2 $\leq$ 5.2)	166 (16.29%)	168 (16.49%)	334 (32.78%)
	Above range (Score2 > 5.2)	89 (8.73%)	236 (23.16%)	325 (31.89%)
	Missing	9 (0.88%)	15 (1.47%)	24 (2.35%)
Life's Essential 8	(mean $\pm$ sd)	Female	Male	Total
Diet		51.41 ($\pm$ 13.11)	50.32 ($\pm$ 13.24)	50.84 ($\pm$ 13.18)
Physical Active		55.34 $\pm$ 42.34	61.47 $\pm$ 40.47	58.53 $\pm$ 41.47
Nicotine		70.91 $\pm$ 40.13	72.09 $\pm$ 38.18	71.52 $\pm$ 39.11
Sleep health		81.3 $\pm$ 23.55	84.41 $\pm$ 20.4	82.92 $\pm$ 22.01
BMI		83.16 $\pm$ 24.43	73.37 $\pm$ 24.28	78.06 $\pm$ 24.83
Cholesterol level		61.19 $\pm$ 28.52	55.62 $\pm$ 25.93	58.29 $\pm$ 27.33
Blood Sugar		22.39 $\pm$ 20.79	26.77 $\pm$ 21.47	24.67 $\pm$ 21.25
Blood Pressure		86.12 $\pm$ 19.06	87.27 $\pm$ 18.65	86.72 $\pm$ 18.85
Mean LE8 ($\pm$ SD)	(mean $\pm$ sd)	63.91 $\pm$ 11.44	63.92 $\pm$ 10.45	63.92 $\pm$ 10.93
LE8 scores based CVH n. (%)	Low (0–49)	57 (5.50%)	46 (4.44%)	103 (9.94%)

Variable	Category	Females n. (%)	Males n. (%)	Total n. (%)
	Moderate (50–79)	383 (36.97%)	446 (43.05%)	829 (80.02%)
	High (80–100)	39 (3.76%)	29 (2.80%)	68 (6.56%)
	Missing	9 (0.87%)	10 (0.97%)	19 (1.64)

Regarding education, over half had a college degree or higher (50.93%), 38.96% completed high school, and 8.15% had elementary or intermediate education. The majority were employed (74.39%), with 8.05% homemakers or unemployed, and 10.01% retired.

More than half had never smoked (53.39%), while 26.10% were ex-smokers, and 19.33% current smokers. Based on BMI, 46.61% were underweight/normal, 39.45% overweight, and 13.84% obese.

Family history revealed that 38.08% reported at least one first-degree relative with CVD or stroke, 44.16% with hypercholesterolemia, 28.56% with diabetes, and 54.47% with hypertension.

The mean SCORE2 was 4.67 ($\pm$ 2.14) overall. In the overall sample, the mean LE8 score was 63.92 ($\pm$ 10.93) with virtually identical values in females and males. According to LE8 based CVH categories, 9.94% of participants were classified as low (0–49), 80.02% as moderate (50–79), and 6.56% as high (80–100).

2.1. HBCVD answers overview

The total number of questionnaires collected was 988 out of 1,019 enrolled patients (96.96%). The overall HBCVD score was 62.30 ($\pm$ 6.15) out of 100. Table S1 provides an overview of the distribution of responses with the mean for each item of the HBCVD subscale.

Regarding susceptibility (maximum score = 20), the mean score was 10.90 and item means ranged from 1.98 to 2.42 on a 1–4 scale, indicating a generally low perceived likelihood of developing a CVD. Most participants disagreed with statements suggesting high personal vulnerability (“It is likely that I will suffer from a CVD...”, “My chances of suffering from a CVD... are great”). The only item with relatively higher endorsement concerned short-term worry (“I am concerned about the likelihood of having a CVD in the near future”).

The severity subscale (maximum score = 20) yielded a mean of 11.30, reflecting a moderately high perception of the seriousness of CVD. The items with the highest means (“My whole life would change if

I had a CVD”, “A CVD would have a very bad effect on my sex life”) indicate that participants perceive CVDs as conditions with substantial impact on quality of life.

The benefits subscale (maximum score = 24) showed the highest overall endorsement, with a mean of 21.00. This reflects a strong and nearly unanimous belief in the benefits of healthy diet and exercise in reducing CVD risk and improving personal well-being. All items scored above 3.35 on average, with the strongest agreement observed for “When I eat healthy, I am doing something good for myself” and “When I exercise, I am doing something good for myself.”

The barriers subscale (maximum score = 36) had a mean of 19.10 and displayed substantial variability across items. Several barriers were rated as minimal, including physical limitations (“It is painful for me to walk for more than 5 minutes”, $M = 1.47$) and financial constraints related to buying healthy food ($M = 1.62$). In contrast, more salient barriers were predominantly logistical or social in nature: limited access to exercise facilities/equipment ($M = 2.91$), lack of someone to exercise with ($M = 2.67$), and, to a lesser extent, insufficient time for exercise ($M = 2.2$).

At the socio-demographic level, a significant association with the HBCVD score was observed only for employment status ($p = 0.035$) (Fig. 1). The highest mean score was found among homemakers/unemployed individuals (63.08), followed by employed (62.36) and other employment categories (62.00), whereas the lowest value was observed among retired participants (61.05).

Figure 1. Overall HBCVD score by a) socio-demographic and b) CV risk factor variables.

Regarding risk factors, significant differences emerged for BMI class ($p = 0.003$), cholesterol family history ($p = 0.023$), and LE8 score ($p = 0.006$). Specifically, the HBCVD score increased across BMI categories, being lowest in normal-weight individuals (61.62), intermediate in those overweight (62.49), and highest among the obese (63.69). Participants with a family history of hypercholesterolemia showed higher scores compared with those without such history (62.70 vs 61.77). Finally, an inverse gradient was observed for the LE8 based CVH, with higher HBCVD scores in the low category (63.94) and lower scores in the high group (60.81).

2.2. Perceived susceptibility

Figure 2 displays the forest plots illustrating perceived susceptibility to CVDs across socio-demographic and risk factors variables.

No significant association between socio-demographic characteristics and perceived susceptibility was found. On the contrary, several significant associations were shown in respect to risk factors. Current smokers reported a significant highest level of perceived susceptibility compared to ex-smokers, never smoker, and ex-smokers ($M = 11.31, 10.87$ and 10.71 , respectively; $p = 0.030$). BMI class was strongly associated with susceptibility ($p < 0.001$), with participants classified as obese reporting a higher score ($M = 11.71$) compared to those with normal ($M = 10.65$) or overweight ($M = 10.82$) BMI. A similar trend

was observed among individuals with a family history of CVD, who reported significantly higher perceived susceptibility ($M = 11.19$) than those without such history ($M = 10.64$) ($p < 0.001$).

Figure 2. Perceived susceptibility to CVDs by a) socio-demographic and b) CV risk factor variables.

Significant associations were also found for family history of hypertension ($p < 0.001$), whereas participants with a positive family history reported higher perceived susceptibility ($M = 11.11$) than those without ($M = 10.41$). A similar pattern was observed for family history of high cholesterol level ($p < 0.001$), with higher susceptibility among those with a positive family history ($M = 11.22$) compared with those without ($M = 10.41$). In contrast, no significant difference was found for diabetes family history.

Finally, CVH as measured by the LE8 score showed a strong inverse relationship with perceived susceptibility ($p < 0.001$). Participants with a low CVH reported the highest susceptibility ($M = 12.04$), while those with a high CVH score reported the lowest ($M = 10.34$).

2.3. Perceived severity

The analysis of the perceived severity subscale revealed significant differences across demographic variables, while no relevant associations were observed in relation to other socio-demographic characteristics and risk factors (Fig. 3).

Figure 3. Perceived severity to CVDs by a) socio-demographic and b) CV risk factor variables.

Females reported significantly higher perceived severity scores compared to males ($M = 11.49$ vs 11.10 ; $p = 0.003$). Age class was also significantly associated with severity perception ($p < 0.001$), with mean scores progressively increasing from younger (30–39 years old: $M = 10.75$) to older individuals (60–69 years old: $M = 11.66$).

2.4. Perceived benefits

Perceived barriers showed noteworthy differences across socio-demographic characteristics but not in respect to risk factors. As shown in the top panel of Fig. 4, sex was a significant factor ($p = 0.005$), with males reporting higher perceived benefits ($M = 21.25$) than females ($M = 20.74$). Age class also showed a significant association ($p = 0.003$), with perceived benefits increasing slightly from older (60–69 years old: $M = 20.49$) to middle-aged groups (50–59 years old: $M = 21.26$). A strong association was observed with education level ($p < 0.001$), with participants having a college degree or postgraduate education reporting the highest perceived benefits ($M = 21.37$), while those with elementary/intermediate education having the lowest scores ($M = 20.01$).

Figure 4. Perceived benefits to CVDs by a) socio-demographic and b) CV risk factor variables.

Employment status was also significantly related to perceived benefits ($p = 0.01$). Employed individuals reported higher mean scores ($M = 21.16$) than those unemployed/homemakers ($M = 20.29$) or retired ($M = 20.49$).

2.5. Perceived barriers

As shown in the forest plots (Fig. 5), perceived barriers to CVD prevention showed significant associations with a limited number of socio-demographic and risk factor variables.

Figure 5. Perceived barriers to CVDs by a) socio-demographic and b) CV risk factor variables.

Among socio-demographic variables, the only significant difference was observed for education level ($p = 0.027$): individuals with an elementary or intermediate education reported the highest perceived barriers ($M = 19.43$), compared to those with a high school diploma ($M = 18.86$) and those with a college degree or postgraduate education ($M = 19.37$).

Regarding risk factor variables, significant differences in perceived barriers were observed across several variables. BMI class was associated with perceived barriers ($p = 0.002$): participants with obesity reported the highest scores ($M = 19.76$), compared to those overweight ($M = 19.29$) or underweight/normal weight ($M = 18.75$). A significant association emerged with the LE8 based CVH ($p < 0.001$). Individuals with a low CVH reported the highest perceived barriers ($M = 19.82$), followed by those with moderate CVH ($M = 19.08$), while participants with a high CVH score had the lowest ($M = 18.03$).

Discussion

This study represents the first Italian investigation exploring CVD risk perception among adults aged 40–69 years old, classified as moderate-to-high risk based on the SCORE2 algorithm but free from clinically diagnosed CVDs.

Using the HBCVD we observed a moderate overall awareness and engagement in health beliefs related to CVDs. Furthermore, significant differences were found across socio-demographic and risk factors.

Our findings showed that women demonstrated significantly higher perceived severity of CVDs than men. This finding aligns with previous research suggesting that women may exhibit greater health awareness and emotional responsiveness to disease threats [27, 28]. However, women also reported lower perceived benefits from prevention, potentially indicating a lack of confidence on preventive measures. These findings are consistent with those reported in a systematic review by Betai et al. (2024) [29], which underscored significant gender-based differences in how individuals perceive cardiovascular risk and engage in preventive behaviours.

An upward trend in perceived severity was observed with increasing age, supporting the hypothesis that older adults may develop heightened concern due to cumulative exposure to illness, either personally or through peers [30, 31]. Despite this, age was not significantly associated with perceived susceptibility or benefits, suggesting that awareness of disease severity alone may not motivate behaviour change. This suggests that interventions for older adults should not solely rely on age-related vulnerability but focus on reinforcing personal perception and empowerment. This suggests that interventions for older adults

should not solely rely on age-related vulnerability but focus on reinforcing personal perception and empowerment.

In our sample higher education levels and employment status were both positively associated with perceived benefits of preventive behaviours. Participants with a college degree or higher scored significantly higher than those with lower education, in line with literature showing that health literacy and education are strong predictors of health engagement [32–34]. Similarly, employed individuals reported higher perceived benefits than unemployed or retired participants. This is consistent with prior findings that link employment with better access to health resources, social support, and preventive care [33]. In contrast, across the other scales, higher values were observed among unemployed participants; however, these differences did not reach statistical significance.

Regarding risk factors, smokers and individuals with obesity reported higher perceived obstacles to adopting preventive measures. This pattern is aligned with previous research [35] which showed that individuals engaged in risky behaviours often recognize their vulnerability but simultaneously feel constrained, psychologically, socially, or practically, from making changes [35]. High perceived barriers in these groups may stem from addiction, failed past attempts at behaviour change, or limited access to supportive environments. All these findings suggest the need for behaviourally targeted strategies that address both motivation and external limitations.

Perceived susceptibility was also significantly higher among participants with a family history of hypertension and hypercholesterolemia. Prior research showed that family history increases personal risk appraisal primarily when the condition is perceived as common, observable, and directly linked to modifiable cardiovascular risk factors [36–38]. Hypertension and hypercholesterolemia are typically managed through routine monitoring and long-term preventive treatment, making them more visible within families and more readily interpreted as signals of future cardiovascular risk. In contrast, diabetes, overt CVD, or stroke may be perceived as conditions affecting older relatives or as outcomes rather than modifiable precursors, which may attenuate their impact on perceived personal susceptibility [37].

Finally, participants in the LE8 high-value category showed higher mean overall HBCVD scores. This finding is consistent with prior evidence indicating that higher LE8 levels are associated with a lower risk of cardiovascular disease, with an inverse relationship between healthier behaviours/factors and CVD that remains robust even after adjustment for potential confounders [39].

The association between LE8 scores and perceptions of benefits and barriers reinforces the reciprocal relationship between objective health status and psychological readiness for change. Individuals with lower CVH based on LE8 scores reported both higher barriers and lower perceived benefits. These results confirm the bidirectional relationship between objective health and perceived ability to take preventive action [16, 21]. This pattern suggests that those in worse health may feel discouraged or powerless to change their habits, while those in better health may be more confident and optimistic about prevention. This underscores the need for tailored interventions that not only address clinical risk but also actively work to reshape beliefs and build self-efficacy in vulnerable populations.

A major strength of this study lies in the first application of the well-established conceptual framework of the HBM within the Italian healthcare context to investigate CVDs risk perception and provide a theoretical foundation for designing preventive interventions. Other strengths of this study include the multicentre design across two diverse Italian regions, the use of validated instruments (HBCVD Scale and LE8), and the comprehensive assessment of demographic, behavioural, and clinical variables. Furthermore, the large sample size enhances the generalizability of the findings to the Italian population.

However, this study has also several limitations. First, although participants were recruited as part of a randomized controlled trial, the present analysis is based on baseline cross-sectional data collected prior to randomization. As such, causality cannot be inferred between cardiovascular risk perception and participants' characteristics. Second, data were self-reported, introducing potential for recall bias and social desirability bias, particularly in relation to sensitive behaviours such as smoking, diet, and physical activity. Third, the sample was recruited in healthcare settings, which may overrepresent individuals who are more health-conscious or more engaged with the health system. This may limit the generalizability of findings to community-dwelling adults. Finally, the HBM, while useful for capturing individual cognitive constructs, does not account for broader contextual, emotional, or structural determinants of behaviour, such as health system barriers, social support, or cultural norms. Future research should consider longitudinal designs, and mixed method approaches to better understand causal relationships and contextual influences on cardiovascular risk perception and preventive behaviour.

Overall, our results emphasize the need for multilevel interventions that consider demographic, behavioural, and clinical profiles to tailor cardiovascular risk awareness initiatives. Public health programs should move beyond standardized approaches and instead adopt differentiated strategies based on individual characteristics.

Conclusions

This study is among the first ones to investigate cardiovascular risk perception using a validated theoretical framework within a population of Italian adults aged 40–69 years, free from overt disease but identified as clinically at moderate-to-high risk. Overall, participants reported a mean overall score of 62.30 ($\pm$ 6.15) out of 100. Mean subscale scores provide a quantitative description of participants' perceptions across the measured domains and can inform the development of interventions targeting cardiovascular prevention and lifestyle behaviours.

Health beliefs varied meaningfully across both socio-demographic characteristics and risk factors. More in depth, differences by sex, age, education, and employment status, indicate that social determinants may shape how individuals interpret CVD threat and value preventive actions. At the same time, behavioural and clinical risk factors, including smoking, BMI class, family history, and LE8, were associated with specific belief domains: most consistently with perceived susceptibility and perceived barriers, and to a lesser extent with perceived severity and perceived benefits. This domain-specific pattern indicates that, even among adults clinically classified as at moderate-to-high risk, risk perception

does not simply mirror objective risk: individuals with different risk profiles differ in how they appraise personal vulnerability and the practical constraints to prevention.

Importantly, subjective perceptions are not always aligned with cardiovascular health based on well-known risk factors, underscoring the limitations of prevention strategies based solely on clinical risk stratification. These results call for more comprehensive preventive interventions that can integrate psychosocial dimensions of risk perception to effectively engage at-risk individuals and reduce the burden of CVDs.

Abbreviations

Abbreviation	Full Term
AHA	American Heart Association
BMI	Body Mass Index
CVD / CVDs	Cardiovascular Disease / Cardiovascular Diseases
CVH	Cardiovascular Health
DALY	Disability-Adjusted Life Years
HBM	Health Belief Model
HBCVD	Health Beliefs Related to Cardiovascular Disease Scale
INNOPREV	INNOvative personalized cardiovascular disease PREvention
LE8	Life's Essential 8
NCT	National Clinical Trial
PNRR	Piano Nazionale di Ripresa e Resilienza
RCT	Randomized Controlled Trial
REDCap	Research Electronic Data Capture
SCORE2	Systematic COronary Risk Evaluation 2
SD	Standard Deviation
WHO	World Health Organization

Declarations

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Declaration of financial/other relationships

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Conflict of interests

None to declare.

Author contributions

All authors contributed to the study design. C.d.W., I.V., M.A., and F.V. drafted the main manuscript text. I.V. performed the data analysis and prepared the figures. All authors contributed to the interpretation of the results, critically reviewed the manuscript, and approved the final version for submission.

Ethics approval

This trial was approved by the Ethics Committee of the Fondazione Policlinico Universitario Agostino Gemelli (approval number 5506). Furthermore, the trial has been approved by the Local Ethics Committee Catania 2 with the protocol number: 149 C.E. (101/CECT2) and by the Local Ethics Committee Palermo 1 with the approval number CE 150109. All procedures adhered to the Declaration of Helsinki and relevant ethical standards. This trial has been registered on ClinicaTrials.gov, with the identifier: NCT05883878.

Patient consent

The participants signed an informed consent form. All information taken from the subjects was coded and kept confidential.

Consent for publication

Not applicable.

Data availability statement

The data are available from the corresponding author on reasonable request.

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Figures

Forest plot HBCVD score

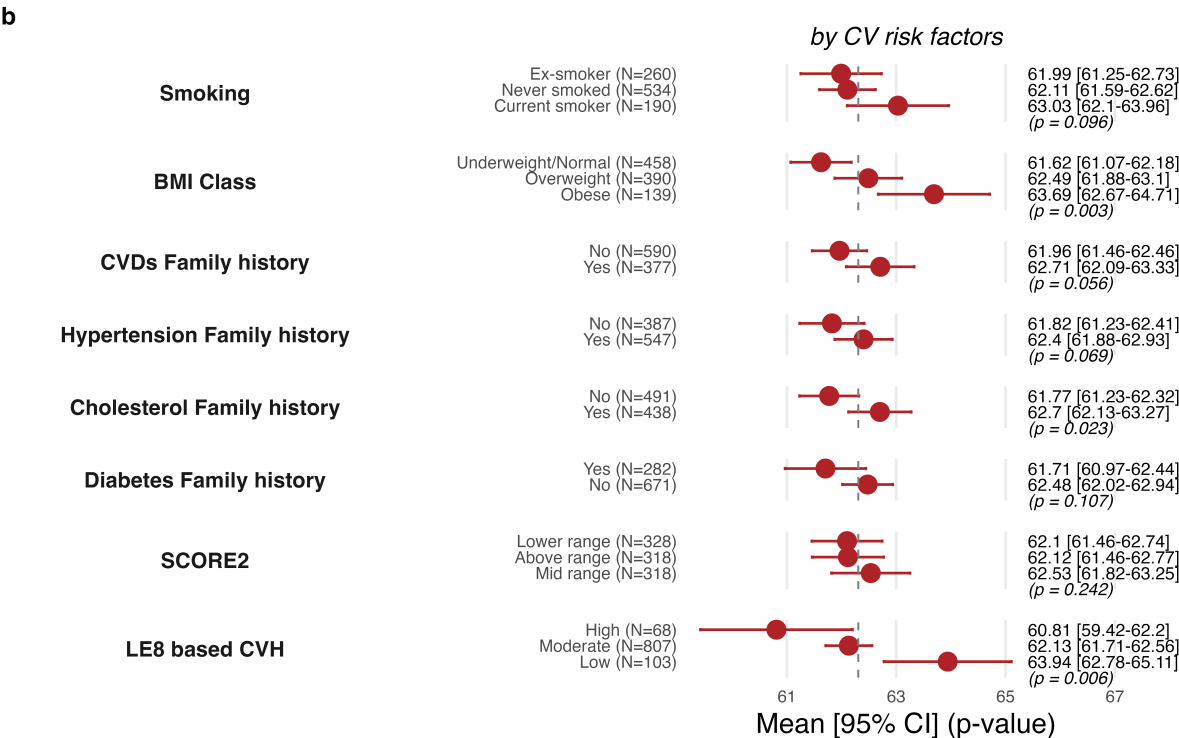
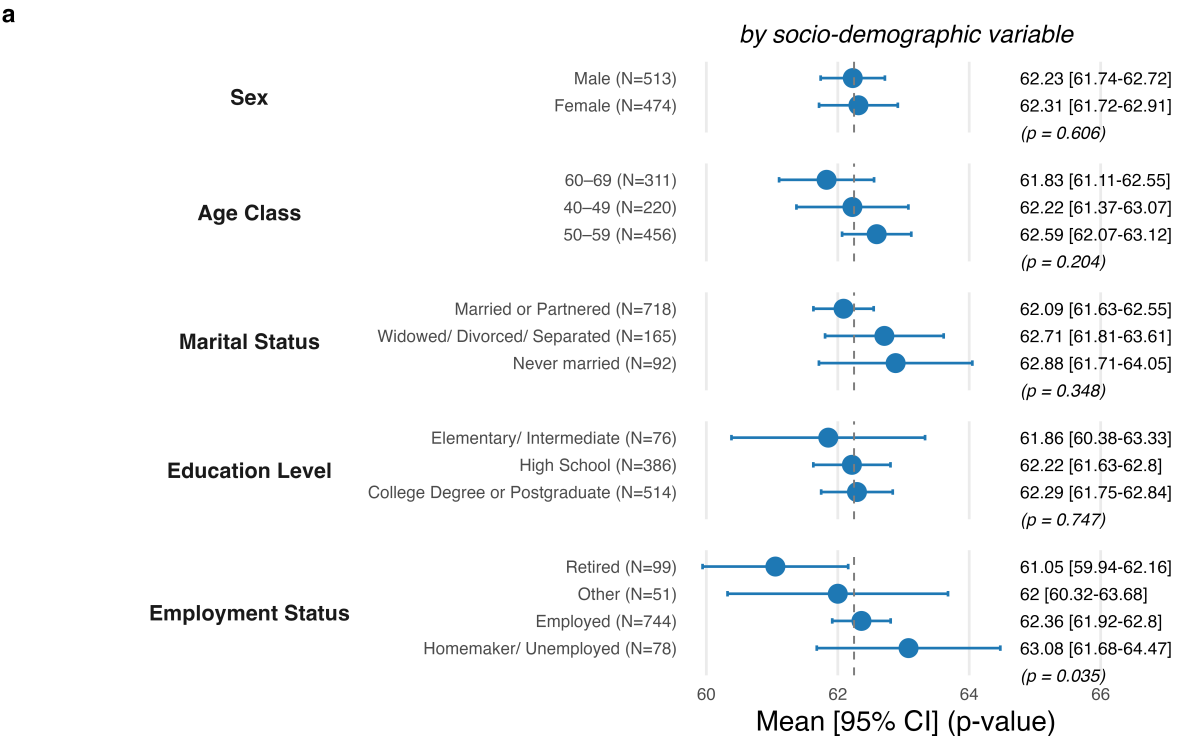


Figure 1

Overall HBCVD score by a) socio-demographic and b) CV risk factor variables.

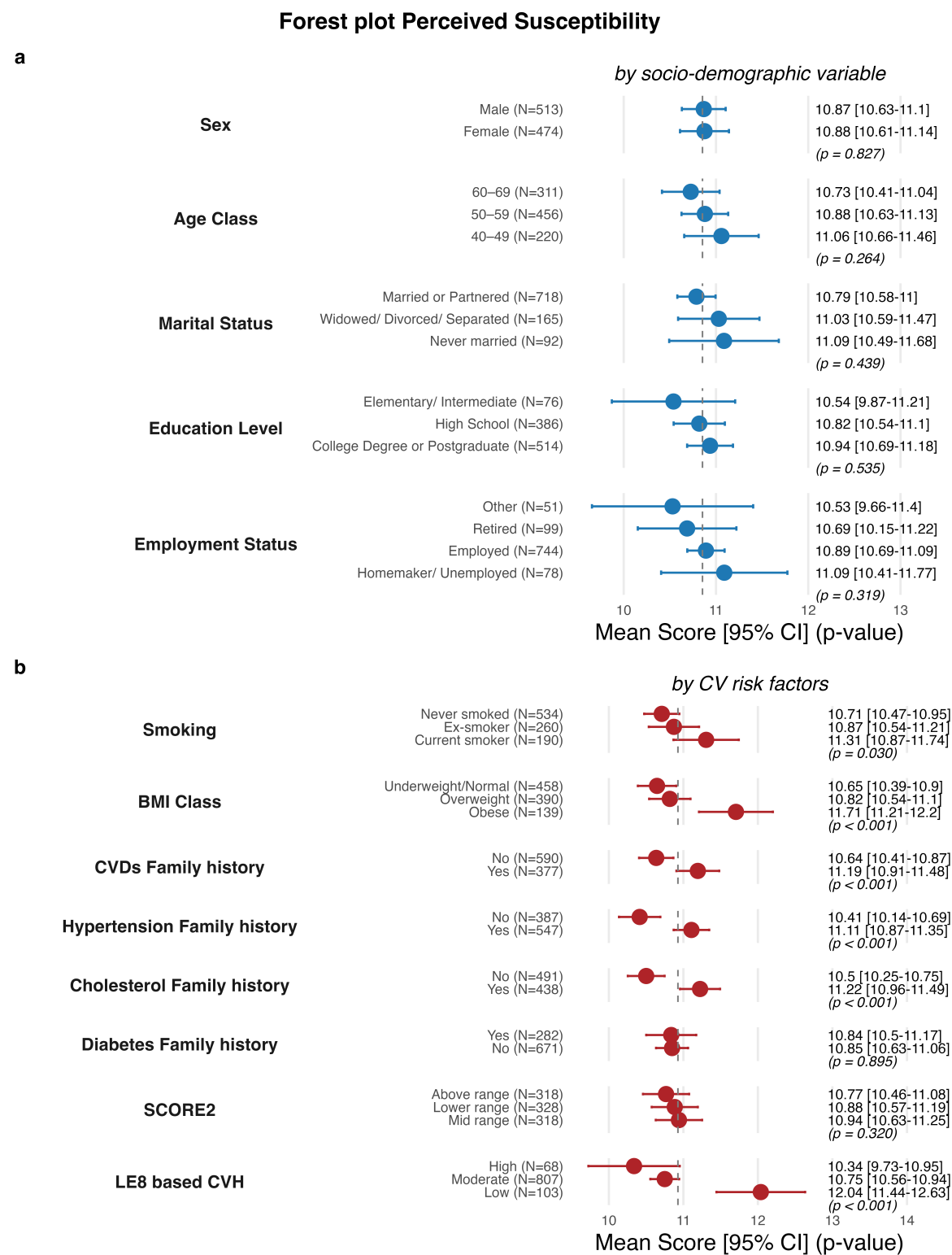
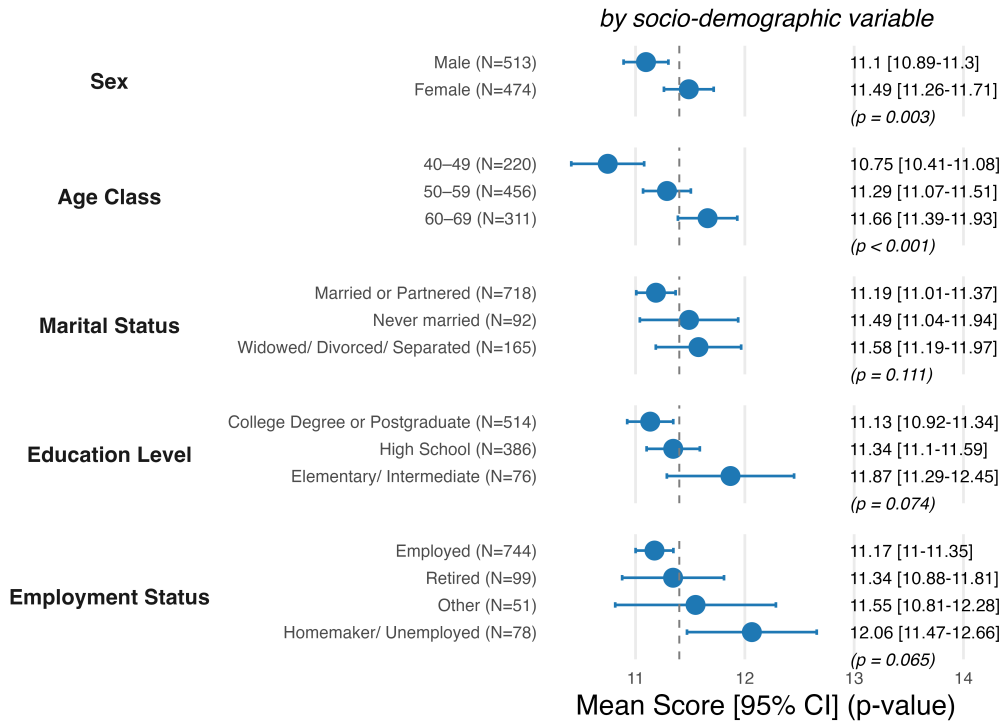


Figure 2

Perceived susceptibility to CVDs by a) socio-demographic and b) CV risk factor variables.

Forest plot Perceived Severity

a



b

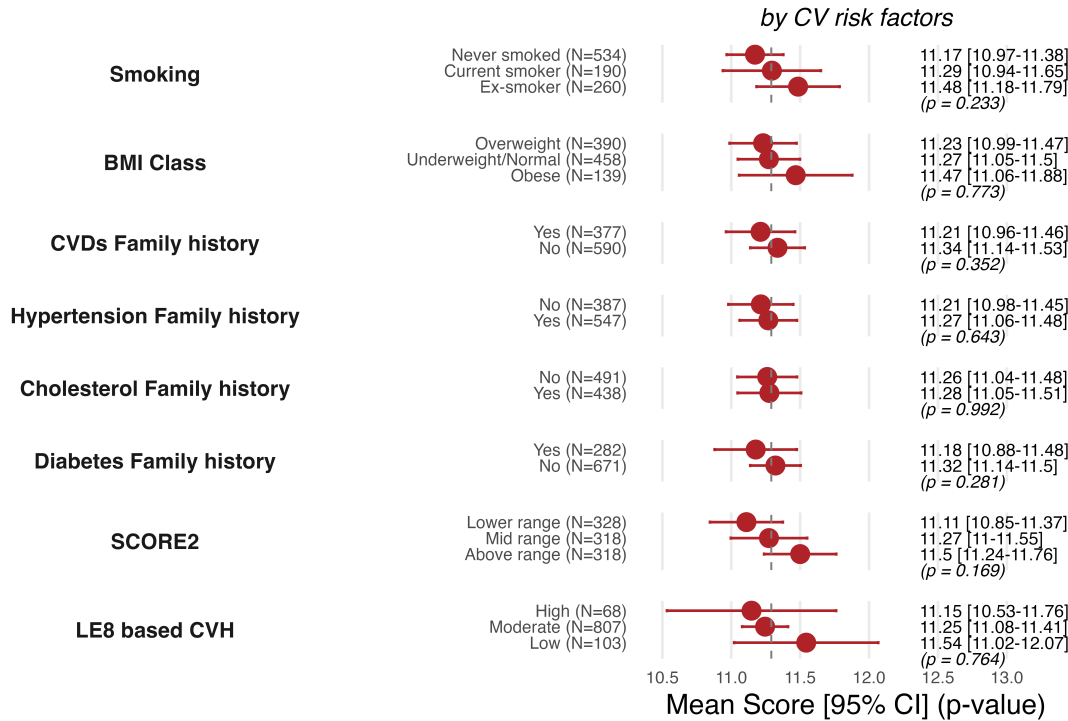
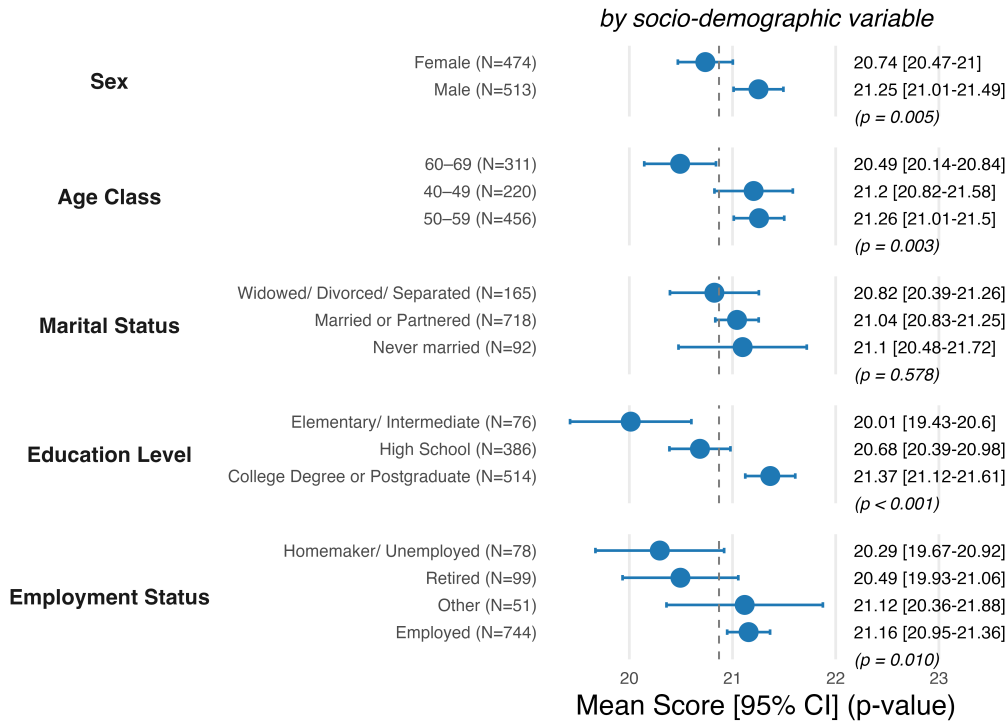


Figure 3

Perceived severity to CVDs by a) socio-demographic and b) CV risk factor variables.

Forest plot Perceived Benefits

a



b

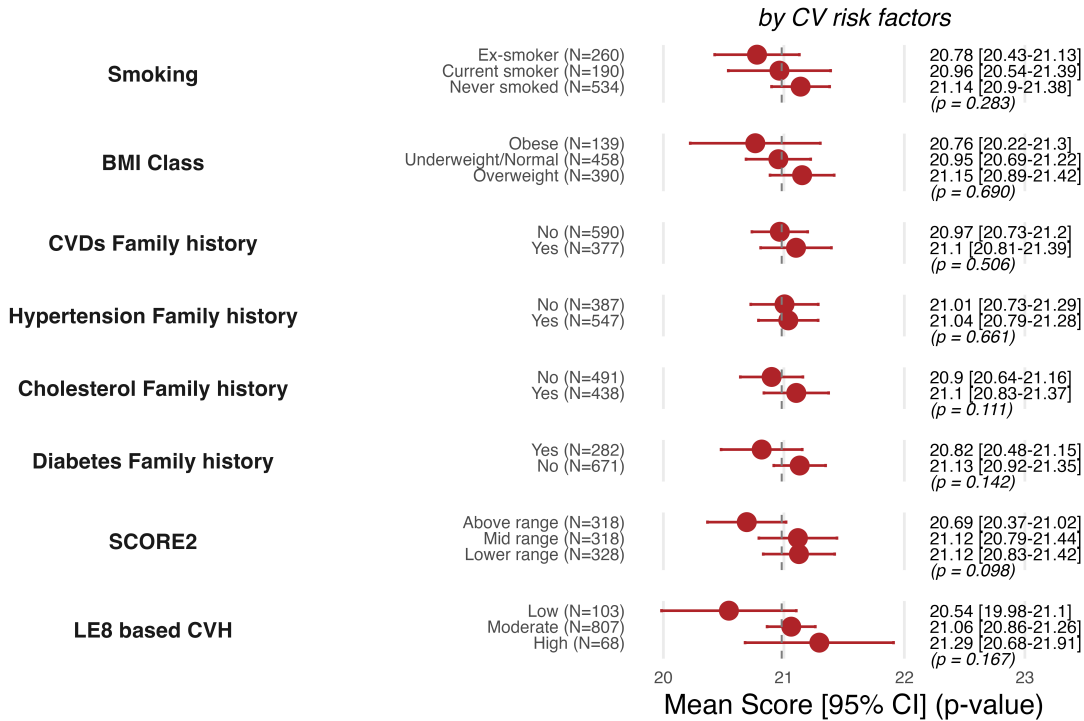
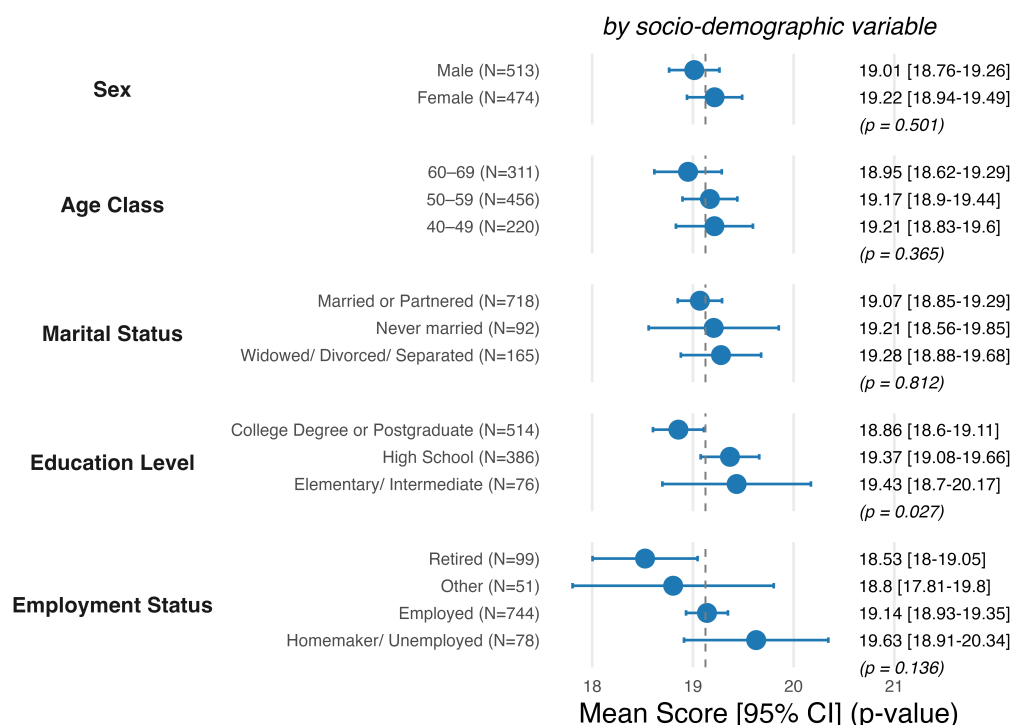


Figure 4

Perceived benefits to CVDs by a) socio-demographic and b) CV risk factor variables.

Forest plot Perceived Barriers

a



b

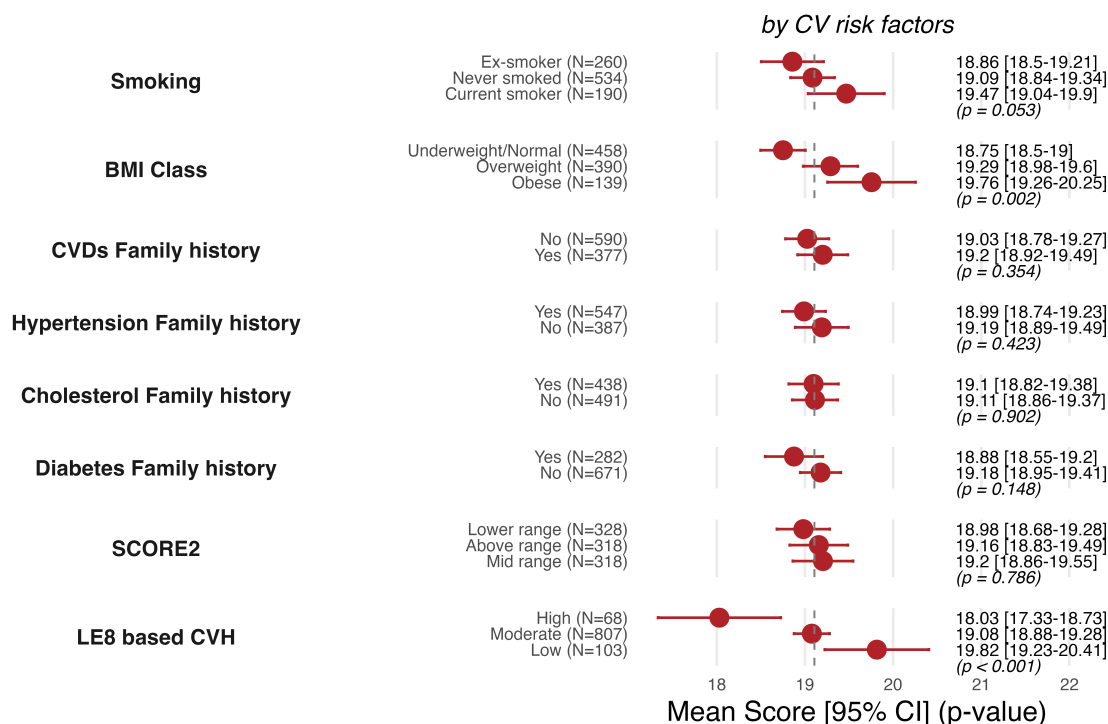


Figure 5

Perceived barriers to CVDs by a) socio-demographic and b) CV risk factor variables.

Supplementary Files

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