Effectiveness of interventions to prevent cardiovascular diseases at the workplace

Giovanni Veronesi, Marco M Ferrario

Research Center in Epidemiology and Preventive Medicine (EPIMED)
University of Insubria, Varese, Italy

STATEMENT SLIDE

I have no conflicts of interest to disclose

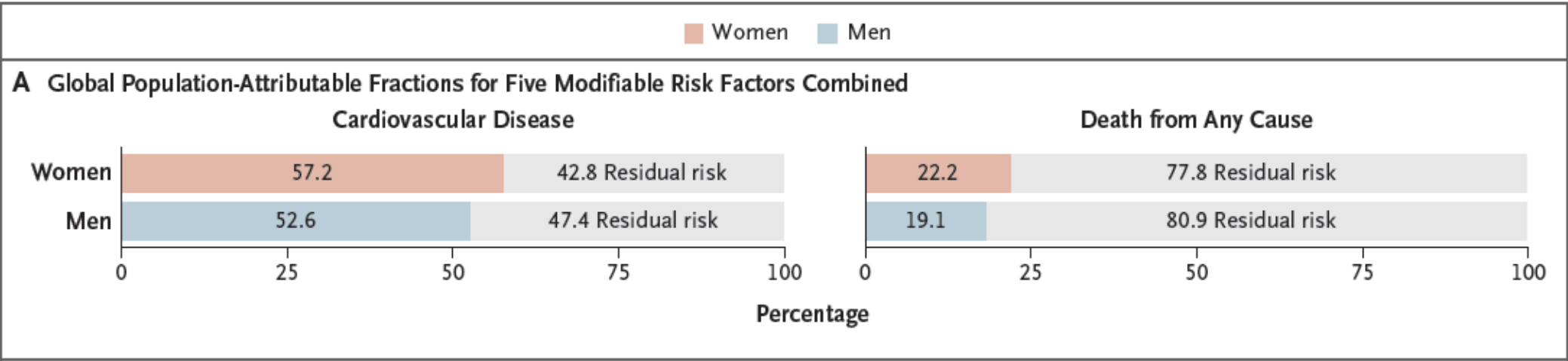# Population Attributable Risk of 5 modifiable risk factors

ORIGINAL ARTICLE

Global Effect of Modifiable Risk Factors on Cardiovascular Disease and Mortality

The Global Cardiovascular Risk Consortium

METHODS

We pooled and harmonized individual-level data from 112 cohort studies conducted in 34 countries and 8 geographic regions participating in the Global Cardiovascular Risk Consortium. We examined associations between the risk factors (body-mass index, systolic blood pressure, non–high-density lipoprotein cholesterol, current smoking, and diabetes) and incident cardiovascular disease and death from any cause using Cox regression analyses, stratified according to geographic region, age, and sex. Population-attributable fractions were estimated for the 10-year incidence of cardiovascular disease and 10-year all-cause mortality.

■ Women   ■ Men

A   Global Population-Attributable Fractions for Five Modifiable Risk Factors Combined

	Cardiovascular Disease		Death from Any Cause	
Women	57.2	42.8 Residual risk	22.2	77.8 Residual risk
Men	52.6	47.4 Residual risk	19.1	80.9 Residual risk

Percentage

Population Attributable Risk of 5 modifiable risk factors

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Global Effect of Modifiable Risk Factors on Cardiovascular Disease and Mortality
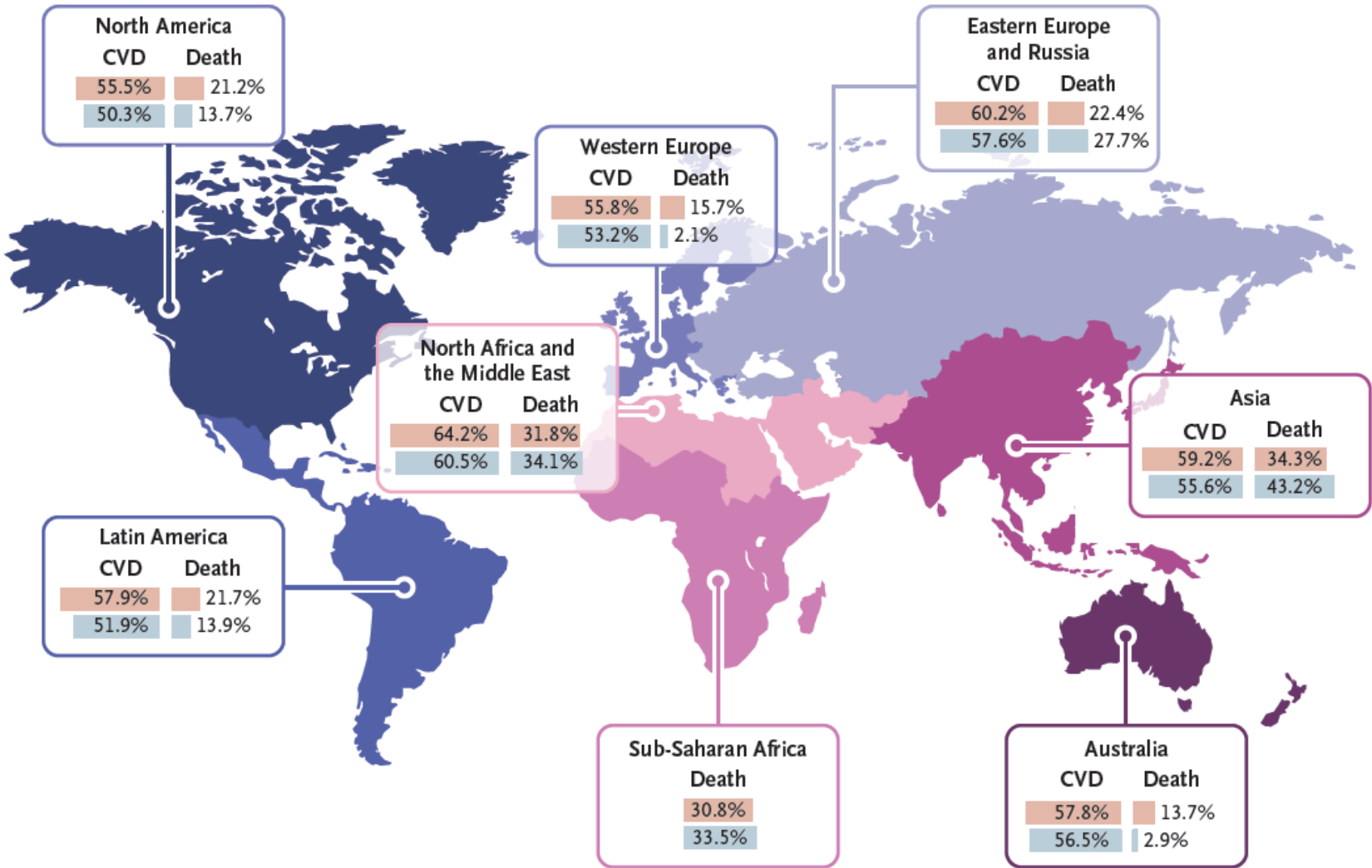
The Global Cardiovascular Risk Consortium

METHODS

We pooled and harmonized individual-level data in 34 countries and 8 geographic regions particip Risk Consortium. We examined associations be index, systolic blood pressure, non–high-density li ing, and diabetes) and incident cardiovascular dise Cox regression analyses, stratified according to Population-attributable fractions were estimated vascular disease and 10-year all-cause mortality.

A Global Population-Attributable Fractions fo

Cardiovascular

Women	57.2	
Men	52.6	

0   25   50
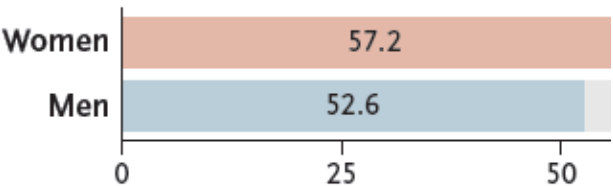
B Population-Attributable Fractions According to Different Regions for Five Modifiable Risk Factors Combined

North America
CVD	Death
55.5%	21.2%
50.3%	13.7%

Eastern Europe and Russia
CVD	Death
60.2%	22.4%
57.6%	27.7%

Western Europe
CVD	Death
55.8%	15.7%
53.2%	2.1%

North Africa and the Middle East
CVD	Death
64.2%	31.8%
60.5%	34.1%

Asia
CVD	Death
59.2%	34.3%
55.6%	43.2%

Latin America
CVD	Death
57.9%	21.7%
51.9%	13.9%

Sub-Saharan Africa
Death
30.8%
33.5%

Australia
CVD	Death
57.8%	13.7%
56.5%	2.9%

Workplace Health Promotion (WPH)

Set of interventions and corporate strategies aimed at **optimizing health of workers** and **their working capacity**, through the **involvement of employers, workers and society at large**

International Association for Worksite HP (IAWHP) Atlanta Announcement on Worksite Health Promotion; 26 march 2009

WHP is the «combined efforts of employers, employees and society **to improve the health and well-being** of **people at work**», achievable through a combination of:

- **Improving the work organization and the working environment**
- Promoting **active participation**
- **Encouraging** personal **development**

European Network for Workplace Health Promotion
Luxemburg declaration, 2018

Effectiveness of WHP programs – Soler et al., 2010

Am J Prev Med 2010;38:S237-S262

A Systematic Review of Selected Interventions for Worksite Health Promotion
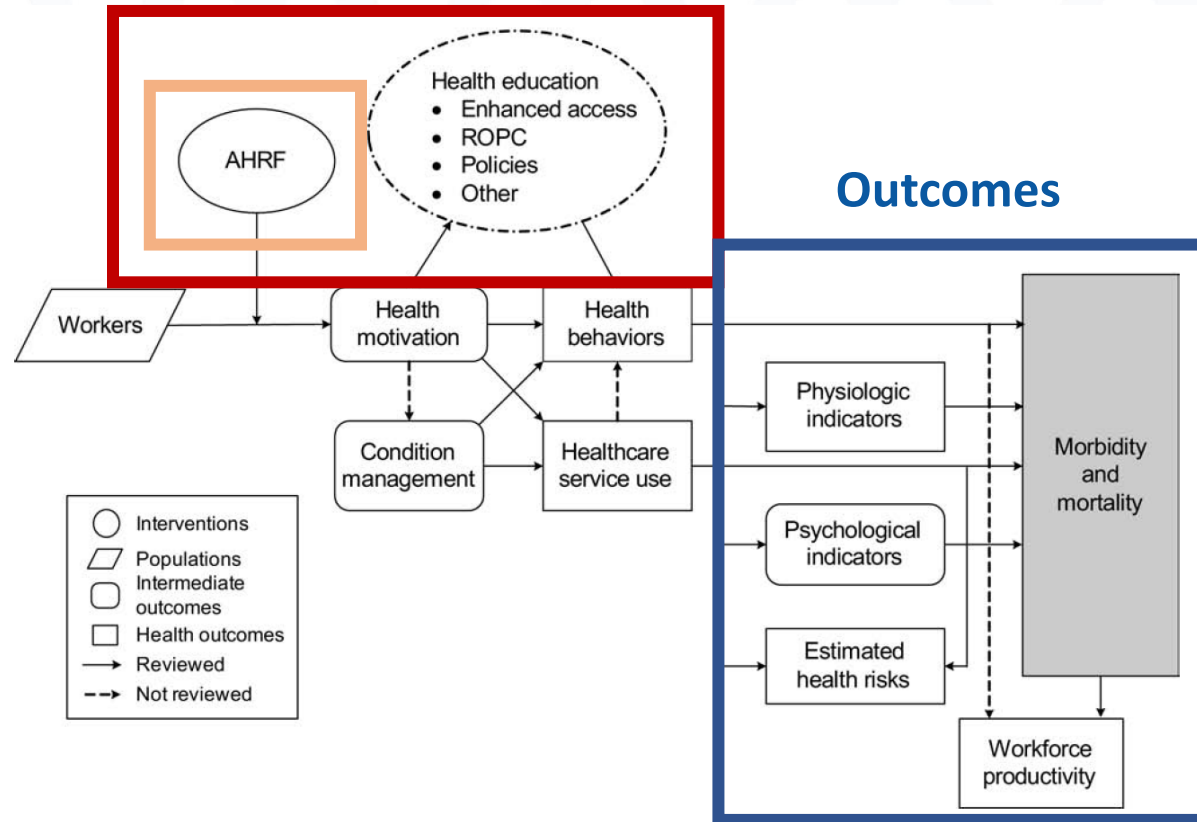The Assessment of Health Risks with Feedback

Outcomes

Figure 1. Analytic framework showing the hypothesized pathways through which AHRF (assessment of health risk with feedback) interventions would affect intermediate and health outcomes
ROPC, reduced out-of-pocket costs

Assessment of Health Risks with Feedback (AHRF):
1. Collect information on at least 2 personal HBs;
2. Risk stratification
3. Feedback to the individual on risk status

AHRF + additional **health related intervention (AHRFplus)**:
- Health education **(HE)**
- Enhanced access **(EA),** such as walking trails, healthy foods in cafeteria, reduced out-of-pocket costs,…
- Policies and *environmental change* **(P):** such as smoking bans, smoking restrictions, vending machine content rules,….
- Incentives **(I)** to participation or to motivation

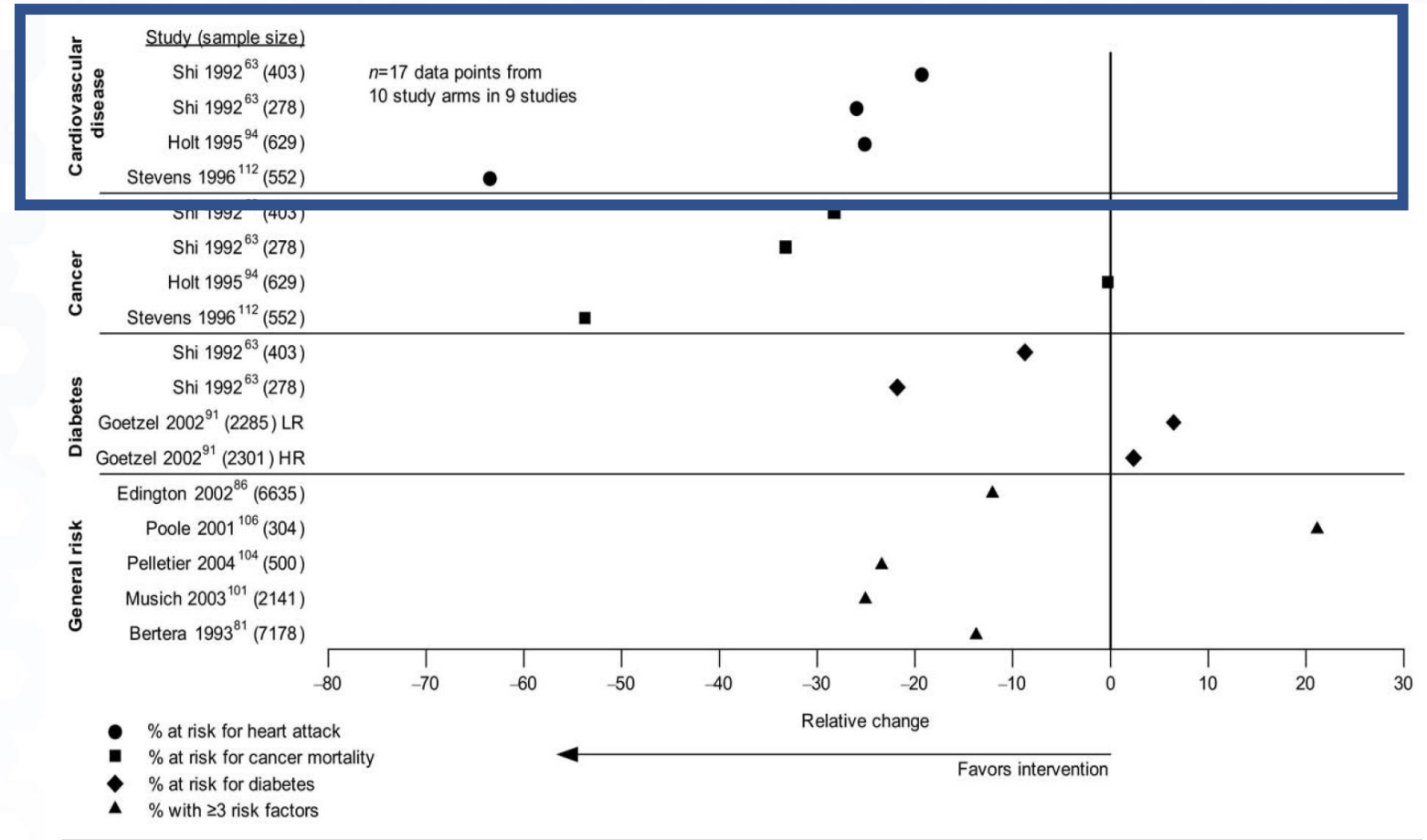# Effectiveness of WHP programs – Soler et al., 2010

AHRF w/HE & periodic re-assessment showed best results on behavioural & physiologic *outcomes*:

- Smoking, alcohol & dietary fat intake
- Cholesterol, PA
- Work absenteism
- Use of seatbelt

NO INTERVENTIONS on work organization and the working environment

Change in estimated CV risk based on risk factors modifications!

Effectiveness of WHP programs – Rongen et al., 2013

Workplace Health Promotion
A Meta-Analysis of Effectiveness

Anne Rongen, MSc, Suzan J.W. Robroek, PhD, Frank J. van Lenthe, PhD, Alex Burdorf, PhD

RCTs on WHP up to June 2012

Evidence acquisition: A systematic literature search was conducted identifying RCTs published before June 2012, evaluating the effect of a WHPP aimed at smoking cessation, physical activity, healthy nutrition, and/or obesity on self-perceived health, work absence due to sickness, work productivity, or work ability. Studies were included in the meta-analyses if quantitative information was present to calculate an effect size (ES). A meta-analysis, stratified meta-analyses, and meta-regression analyses were performed in Spring 2012 using Comprehensive Meta-analysis software 2.0 and PAWS 17.0.2.

NO INTERVENTIONS on work organization and the working environment

Major findings:

- **SMALL overall effect size,** on selected outcomes only (self-perceived health, work absence, work ability)
- Effectiveness was the **largest** in **white collars** and in the **youngest** (<40 y.o.)
  AND
- Better results reported by studies with **lower quality – reporting bias!**
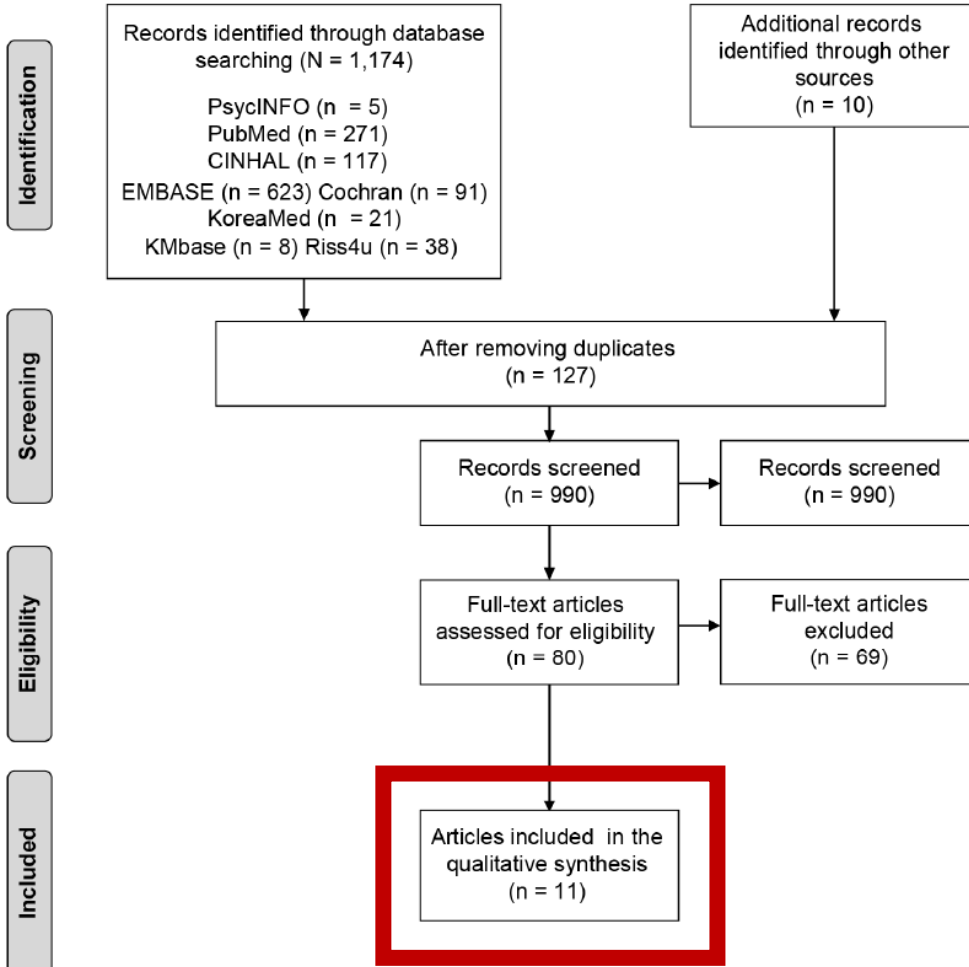
Effectiveness of WHP programs – Hwang et al., 2020

Review

Interventions to Reduce the Risk of Cardiovascular Disease among Workers: A Systematic Review and Meta-Analysis

RCTs on WHP & CVD risk, published from 1981 to 2018

- **11 studies selected for SR, 1 further excluded from MA** based on low quality
- 6 from the US, 1 Korea, 1 Japan, 2 Netherlands
- **Target populations of selected workers by** clinical condition (hypertension, overweight, T2DM), presence of RFs, sex, race, in several combinations
- All interventions were **applied lifestyle programs** including PA and diet

BUT

NO INTERVENTIONS on work organization and the working environment!

Effectiveness of WHP programs – Hwang et al., 2020

Outcomes	Effect Size		
	No. of Studies	Hedges'	95% CI
SBP	10	0.66	0.27, 1.60
DBP	9	0.63	0.21, 1.06
BMI	6	0.71	0.15, 1.26
Weight	6	0.19	−0.78, 0.46
LDL	5	0.46	−0.02, 0.93

Large heterogeneity of interventions by setting [clinic vs. workplace], duration [4-12 months] mode [individual vs. group], type [remote vs. on-site], follow-up period [less vs. more than 12 months]

Effectiveness of WHP programs – Hwang et al., 2020

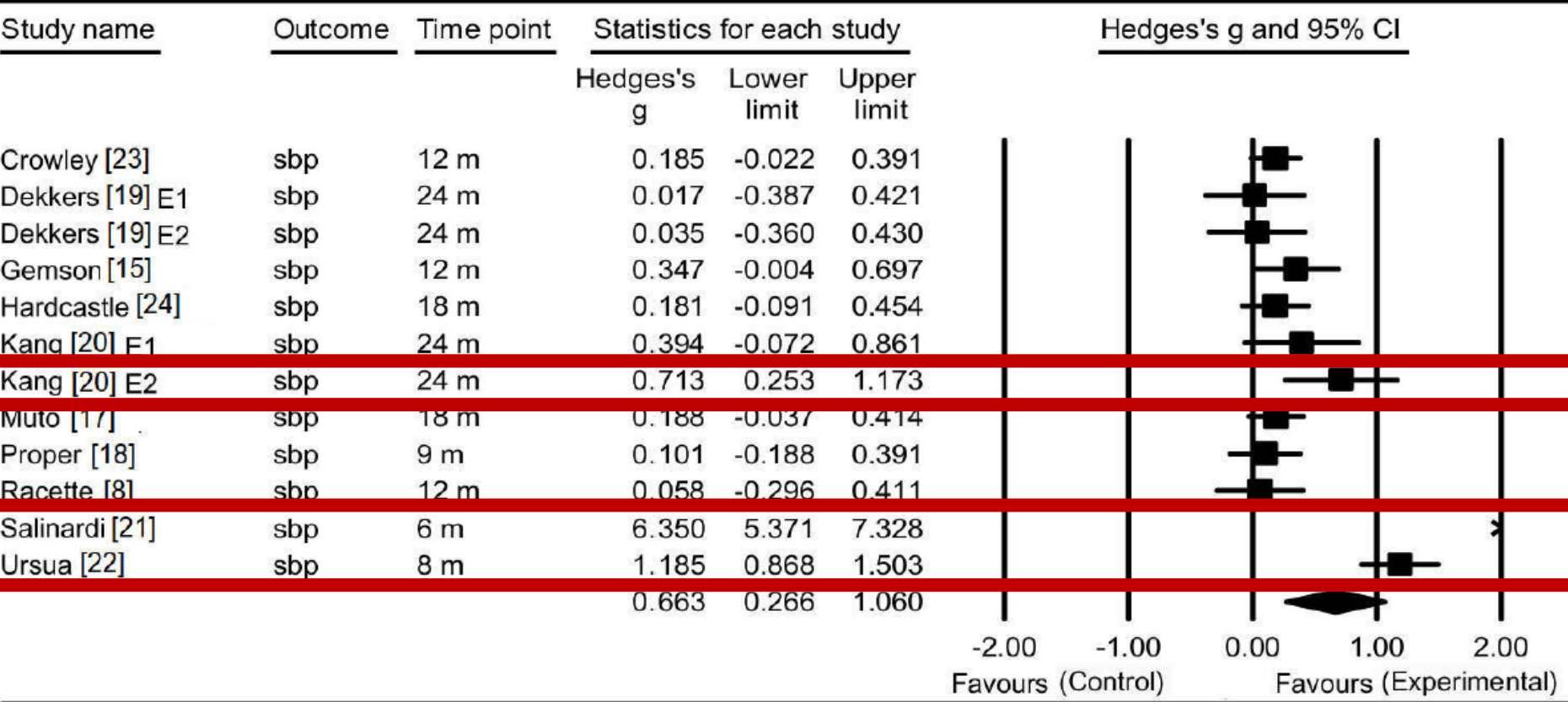| Outcomes	Effect Size		
	No. of Studies	Hedges'	95% CI
SBP	10	0.66	0.27, 1.60
DBP	9	0.63	0.21, 1.06

Large heterogeneity of interventions by setting [clinic vs. workplace], duration [4-12 months] mode [individual vs. group], type [remote vs. on-site], follow-up period [less vs. more than 12 months]

Study name	Outcome	Time point	Statistics for each study			Hedges's g and 95% CI
			Hedges's g	Lower limit	Upper limit	
Crowley [23]	sbp	12 m	0.185	-0.022	0.391	
Dekkers [19] E1	sbp	24 m	0.017	-0.387	0.421	
Dekkers [19] E2	sbp	24 m	0.035	-0.360	0.430	
Gemson [15]	sbp	12 m	0.347	-0.004	0.697	
Hardcastle [24]	sbp	18 m	0.181	-0.091	0.454	
Kang [20] E1	sbp	24 m	0.394	-0.072	0.861	
Kang [20] E2	sbp	24 m	0.713	0.253	1.173	T2DM, males
Muto [17]	sbp	18 m	0.188	-0.037	0.414	
Proper [18]	sbp	9 m	0.101	-0.188	0.391	
Racette [8]	sbp	12 m	0.058	-0.296	0.411	
Salinardi [21]	sbp	6 m	6.350	5.371	7.328	**Overweight**
Ursua [22]	sbp	8 m	1.185	0.868	1.503	Hypertension, race
			0.663	0.266	1.060	

-2.00 -1.00 0.00 1.00 2.00

Favours (Control) Favours (Experimental)

Effectiveness of WHP programs – Pesis-Katz et al., 2020

Long-term impact of the University of Rochester Employee Wellness Program on reducing CVD risk

1. 16284 unique participants in 2013-17, 9116 for more than 1 year (**56%**);
2. **AHRFp:** customised wellness assessment & personalized comprehensive intervention [Health Education & Incentives];
3. 67% women, 82% white/Caucasian, **94% w/bachelor degree or higher**
4. Results reported only for the 1462 (**9% of the total**) individuals with **moderate-to-very high 10 yrs CVD risk at baseline**

NO INTERVENTIONS on work organization and the working environment!

Health risk measure	n (%) High risk at baseline	% decrease in n high risk	P
Total number	1462		
MODIFIABLE MEASURES			
Smoker	237 (16.2%)	-23.6%	.0031
Total cholesterol ≥200	388 (26.5%)	-15.5%	.0099
HDL <40	862 (59.0%)	-29.8%	<.0001
Systolic blood pressure ≥140	336 (23.0%)	-31.8%	<.0001
Diastolic blood pressure ≥90	362 (24.8%)	-41.7%	<.0001

Framingham CVD risk category	n at baseline (#)	Improved 10-year risk score, n (%)
2 = Moderate Risk	1119	544 (48.6%)
3 = High Risk	249	117 (47.0%)
4 = Very High Risk	94	39 (41.5%)
Total	1462	700 (47.9%)

ESC2021 GL: population-based interventions at the workplace

	Class	Level	Type
Physical activity			
Comprehensive corporate wellness programmes should be considered with nutrition and PA components, possibly with medical supervision and governance	IIa	B	AHRFp
Structured corporate wellness programmes that encourage PA also during work hours. Improving stairway access and appeal, potentially in combination with elevators that skip some floors, should be considered.	IIa	C	EA
Promoting worksite fitness centres/gyms should be considered	IIa	C	I
Diet			
At all companies, a coherent and comprehensive health policy and nutritional education are recommended to stimulate the health awareness of employees.	I	B	P+HE
Increased availability of fresh drinking water and improved nutritional quality of food served and/or sold in the workplace, and in vending machines, should be considered	IIa	C	EA
Smoking			
Workplace-specific bans on smoking to reduce passive smoking and increase quit rates are recommended	I	A	P
Workplace policy on tobacco cessation/prevention is recommended	I	A	P
Alcohol abuse			
At every company, a coherent and comprehensive health policy and nutritional education on stimulating the health of employees, including limiting excessive alcohol intake, are recommended	I	B	P+HE

Class of recommendation: I=recommended/indicated; IIa=should be considered

Level of evidence: A=data derived from multiple RCTs or M-A; B=single RCT or large non-randomized studies; C=small studies, retrospective studies, registries

ESC2021 GL: interventions at the individual level

2021 ESC guidelines on cardiovascular disease prevention in clinical practice.
Eur Heart J 2021;42:3227-3337

Recommendations for physical activity

Recommendations	Class[a]	Level[b]
It is recommended for adults of all ages to strive for at least 150 - 300 min a week of moderate-intensity or 75 - 150 min a week of vigorous-intensity aerobic PA, or an equivalent combination thereof, to reduce all-cause mortality, CV mortality, and morbidity.[371,372]	I	A

In employed populations, **sedentarism is mainly WORK-related,** but **are interventions at the workplace really effective?**
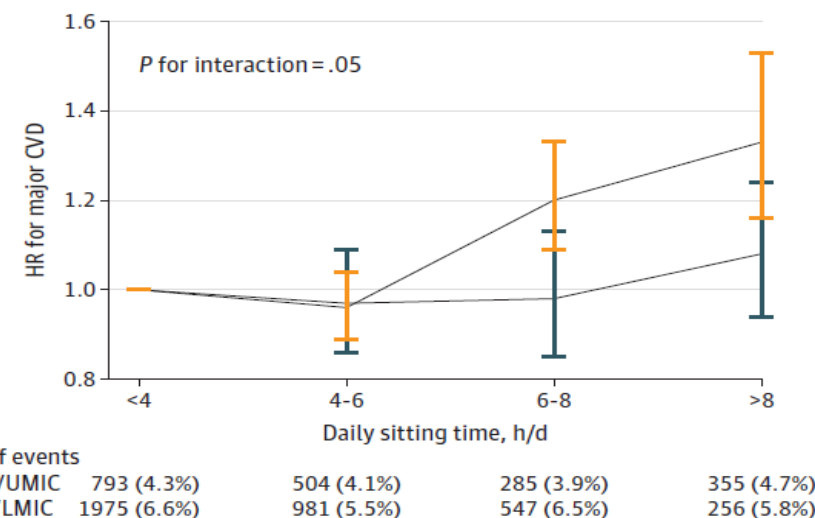What might be the **added value of doing interventions at the workplace?**

Research

JAMA Cardiology | Original Investigation

Association of Sitting Time With Mortality and Cardiovascular Events in High-Income, Middle-Income, and Low-Income Countries

Sidong Li, BM; Scott A. Lear, PhD; Sumathy Rangarajan, MSc; Bo Hu, PhD; Lu Yin, PhD;

A, Composite outcome, B, all-cause mortality, and C, major cardiovascular disease (CVD) adjusted for age, sex, urban or rural residence, country

From WHP to TWH

Total Worker Health® is defined as policies, programs, and practices that **integrate protection** **from work-related safety and health hazards**, **with promotion of injury** and **illness prevention efforts to advance worker well-being** .
[*Research Compendium – NIOSH – TWH 2012*]

For time being, there is no solid evidence of effectiveness of CVD prevention efforts based on this approach, combining individual-based and work related risk factors


Fundamentals of
***Total Worker Health*® Approaches**
Essential Elements for Advancing
Worker Safety, Health, and Well-Being

Protect Workers

Demonstrate Leadership Commitment

Design Work to Eliminate Hazards

Engage Workers

Ensure Confidentiality

Integrate Systems

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

Time for precision in CVD prevention, at the workplace?

INTERACTIONS WITH ENVIRONMENTS
AS TOOLS FOR WELL-BEING

The 15th International Conference on Combined Actions
and Combined Effects of Environmental Factors
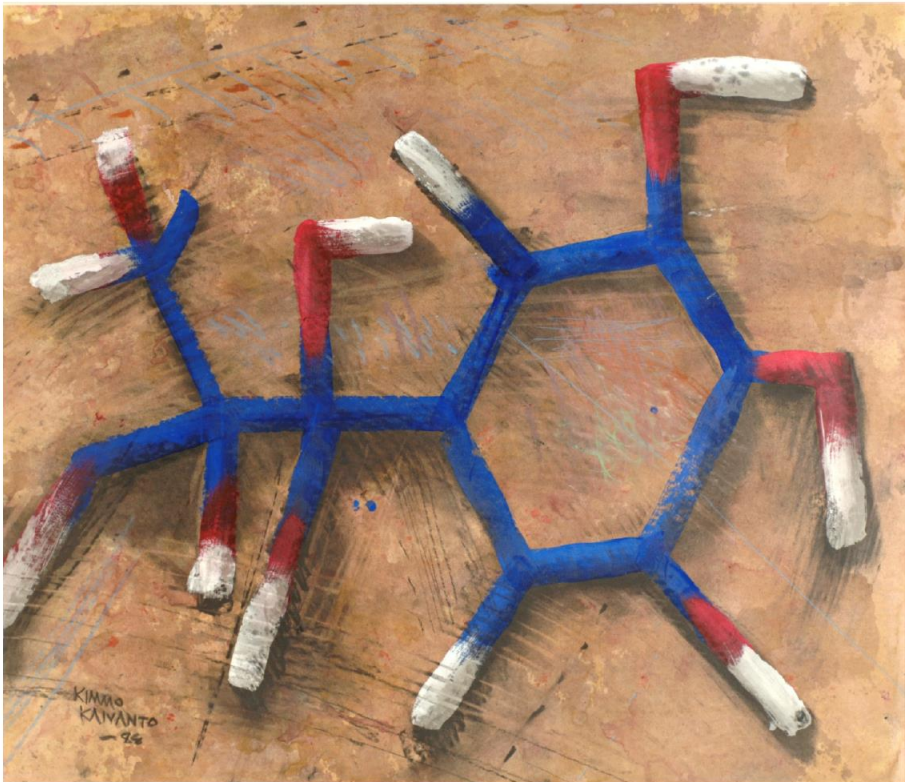
18–20 September 2016
Tampere, Finland

Scientific evidence of the health effects of the **interaction between occupational risk profile and individual risk profile** is the path of **PRECISION Prevention,** through the **identification of more susceptible workers**

Bringing interventions to who really needs!

Some examples follows

Occupational and Sport PA

Table 1 Risk factors-adjusted HRs (with 95% CIs) for SpPA in different OPA categories, and test for SpPA–OPA interaction on the incidence of CHD and CVD events

OPA	SpPA	N	CHD events (n=135)		CVD events (n=174)	
			Rate	HR (95% CI)	Rate	HR (95% CI)
Low	Poor	799	4.09	Ref	4.79	Ref
Low	Intermediate/ recommended	544	1.56	0.45 (0.24 to 0.87)	1.86	0.45 (0.25 to 0.82)
Intermediate	Poor	673	2.01	Ref	2.98	Ref
Intermediate	Intermediate/ recommended	454	2.29	1.20 (0.54 to 2.67)	2.41	0.93 (0.43 to 1.98)
High	Poor	759	2.40	Ref	3.57	Ref
High	Intermediate/ recommended	345	3.56	1.84 (0.88 to 3.87)	4.98	1.66 (0.87 to 3.14)
Heterogeneity test p value*	–	–	–	0.02	–	0.01
Interaction test p value†	–	–	0.02	–	0.01	

Sedentary workers: **sport PA is protecive**

High levels of OPA workers: **sport PA is a risk factor**

To cite: Ferrario MM, Roncaioli M, Veronesi G, *et al*. *Heart* 2018;**104**:1165–1172.

Occupational and Sport PA

2018

> **How might this impact on clinical practice?**
> The increasing number of sedentary workers in postindustrialised societies asks for specific interventions to promote SpPA even at the workplace. If our results were confirmed in larger studies, the CVD prevention recommendation of SpPA ought to consider the level of OPA.

Editorial

Preventing disease by integrating physical activity in clinical practice: what works for whom?

Pieter Coenen

Heartbeat

Heartbeat: Is all physical activity beneficial for cardiovascular health?

doi:10.1136/heartjnl-2018-313725

Catherine M Otto

ESC 2021 guidelines

Recommendations	Class[a]	Level[b]
It is recommended for adults of all ages to strive for at least 150 - 300 min a week of moderate-intensity or 75 - 150 min a week of vigorous-intensity aerobic PA, or an equivalent combination thereof, to reduce all-cause mortality, CV mortality, and morbidity.[371,372]	I	A

=

ESC 2016 guidelines

Recommendations	Class[a]	Level[b]	Ref[c]
It is recommended for healthy adults of all ages to perform at least 150 minutes a week of moderate intensity or 75 minutes a week of vigorous intensity aerobic PA or an equivalent combination thereof.	I	A	258–261

Job Strain

Job strain and the incidence of coronary heart diseases: does the association differ among occupational classes? A contribution from a pooled analysis of Northern Italian cohorts

Hazard ratio for **high vs. low strain**, in **manual & Routine non-manual workers**
N=4103 men 25-64 y.o., n=172 CHD events

HR (95%CI) per CHD	All sample	Managers & Proprietors	Manual & Non-manual workers	p-value interazione
High vs. Low strain	**1.57 (1.01-2.44)**	0.60 (0.25; 1.47)	**2.92 (1.54-5.51)**	0.04

Full research paper

European Journal of
Preventive
Cardiology

ESC
European Society
of Cardiology

Exploring the interplay between job strain and different domains of physical activity on the incidence of coronary heart disease in adult men

European Journal of Preventive Cardiology
2019, Vol. 26(17) 1877–1885
© The European Society of Cardiology 2019
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/2047487319852186
journals.sagepub.com/home/cpr

SAGE

Marco M Ferrario[1,2], Giovanni Veronesi[1], Mattia Roncaioli[3], Andreas Holtermann[4,5], Niklas Krause[6], Els Clays[7], Rossana Borchini[1,2], Guido Grassi[8] and Giancarlo Cesana[9]; on behalf of The Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group

Both in the entire sample and in worker with poor SpPA, we found increased excess risks in sedentary worker with high strain, but we did not found clear interaction effects.

Interventions at the workplace to improve SpPA and reduce JS in sedentary workers seem preeminent

Joint effect of sedentary work & job strain according to sport PA levels
N=3310 men 25-64 y.o., n=120 CHD events

All workers	No SpPA	Int/rec SpPA	p-value interaction
2.53 (1.29-4.97)	**3.95 (1.79-8.68)**	0.32 (0.04-2.70)	0.66

Reference category for HRs: non-high strain & intermediate PA workers

CVD risk stratification at the workplace

Accuracy of lifestyles + work-related RFs:

	Calibration	Discrimination[a]		Δ-AUC[b] (95% CI)	
		AUC (95% CI)			
M1: age, smoking status	10.9	0.724	(0.684; 0.759)	REF	
M2: M1 + sport PA, alcohol consumption	6.0	0.734	(0.692; 0.764)	0.010	(0.002; 0.019)
M3: M1 + occupational PA, job strain	16.6	0.736	(0.691; 0.767)	0.012	(0.004; 0.021)
M4: M1 + combined occupational and sport PA, alcohol consumption and job strain	14.3	0.753	(0.700; 0.780)	0.028	(0.011; 0.04)
M5: M1 + total cholesterol, HDL-cholesterol, systolic blood pressure and diabetes	10.7	0.753	(0.713; 0.779)	0.029	(0.012; 0.044)

CVD risk stratification at the workplace

Cardiovascular disease prevention at the workplace: assessing the prognostic value of lifestyle risk factors and job-related conditions

Giovanni Veronesi[1] · Rossana Borchini[2] · Paul Landsbergis[3] · Licia Iacoviello[1,4] · Francesco Gianfagna[1,4] · Patrick Tayoun[5] · Guido Grassi[6,7] · Giancarlo Cesana[8] · Marco Mario Ferrario[1,2] on behalf of The Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group

Clinical utility of lifestyles+work-related RFs in low-risk workers:

Table 5 Discrimination and clinical utility parameters for the risk estimation model based on lifestyle risk factors and job-related conditions (LS&JRC), among workers without clinical CVD risk factors or at low CVD risk according to guidelines. Brianza (Northern Italy), 1989–2008

	N	# events	Observed 10-years risk	AUC	Workers with LS&JRC risk above the observed 10-year risk[a]				NNS	Net Benefit (95% CI)
					N	%	Sensitivity	Specificity		
Total cholesterol < 240 mg/dl	1811	95	3.4	0.754	695	38.4	0.719	0.628	15.6	1.19 (0.57; 2.01)
Systolic BP < 140 mmH, no treatment	908	51	3.3	0.743	406	44.7	0.830	0.566	16.2	1.32 (0.47; 2.78)
No diabetes	2447	145	4.0	0.753	822	33.6	0.665	0.678	12.6	1.38 (0.64; 2.05)
Low CVD risk[a]	1832	91	3.3	0.745	687	37.5	0.746	0.638	15.2	1.27 (0.68; 2.16)

Cardiovascular disease prevention at the workplace: assessing the prognostic value of lifestyle risk factors and job-related conditions

Giovanni Veronesi[1] · Rossana Borchini[2] · Paul Landsbergis[3] · Licia Iacoviello[1,4] · Francesco Gianfagna[1,4] · Patrick Tayoun[5] · Guido Grassi[6,7] · Giancarlo Cesana[8] · Marco Mario Ferrario[1,2] on behalf of The Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group

Int J of Public Health 2018:63:723-32

Conclusions: **LS&JRC are as accurate as clinical risk factors** in identifying future cardiovascular events among working males. Our results **support initiatives to improve total health at work** as strategies to prevent cardiovascular disease.

Table 3 Discrimination and clinical utility parameters for the risk estimation model based on lifestyle risk factors and job-related conditions (LS&JRC), among workers without clinical CVD risk factors or at low CVD risk according to guidelines. Brianza (Northern Italy), 1989–2008

	N	# events	Observed 10-years risk	AUC	Workers with LS&JRC risk above the observed 10-year risk[a]				NNS	Net Benefit (95% CI)
					N	%	Sensitivity	Specificity		
Total cholesterol < 240 mg/dl	1811	95	3.4	0.754	695	38.4	0.719	0.628	15.6	1.19 (0.57; 2.01)
Systolic BP < 140 mmH, no treatment	908	51	3.3	0.743	406	44.7	0.830	0.566	16.2	1.32 (0.47; 2.78)
No diabetes	2447	145	4.0	0.753	822	33.6	0.665	0.678	12.6	1.38 (0.64; 2.05)
Low CVD risk[a]	1832	91	3.3	0.745	687	37.5	0.746	0.638	15.2	1.27 (0.68; 2.16)

DISCUSSION & CONCLUSIONS

- 5 modifiable risk factors contribute up to 50-60% of CVD events. **Room for other risk factors, including work-related!**

- **Poor evidence of effectiveness of WHP interventions** on a few CVD risk factors: smoking & systolic BP, in highly-educated workers & in Countries with poor public healthcare coverage

- **Methodological concerns on the quality of published studies**: poor baseline program adherence, attrition over time, small sample sizes, & publication bias

- **For time being, no evidence on the effectiveness of THW** (defined according to the NIOSH approach)

- We show the **potential effectiveness of selective interventions at the workplace reducing individual-based AND work environmental/organizational risk factors. Time to put them in place?**

AKNOWLEGEMENTS

Research Center in Epidemiology and Preventive Medicine (EPIMED),
Dept. of Medicine and Surgery.
University of Insubria, Varese, Italy.
https://epimed.uninsubria.eu/

Marco M Ferrario, senior professor of occupational medicine
Giovanni Veronesi, professor of biostatistics
Francesco Gianfagna, professor of hygiene and public health
Emanuele M Giusti, tenure-track researcher in biostatistics

Effectiveness of WHP programs

- Soler RE, Leeks KD, Razi S, et al.; Task Force on Community Preventive Services. A systematic review of selected interventions for worksite health promotion. The assessment of health risks with feedback. *Am J Prev Med*. 2010;38(2 Suppl):S237-62.

- Rongen A, Robroek SJW, van Lenthe FJ, Burdorf A. Workplace health promotion: a meta-analysis of effectiveness. *Am J Prev Med*. 2013;44(4):406-415.

- Hwang WJ, Kang SJ. Interventions to Reduce the Risk of Cardiovascular Disease among Workers: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health*. 2020;17(7):2267.

- Pesis-Katz I, Smith JA, Norsen L, DeVoe J, Singh R. Reducing Cardiovascular Disease Risk for Employees Through Participation in a Wellness Program. *Popul Health Manag*. 2020;23(3):212-219.

Job-related risk factors and CVD risk

- **Ferrario MM, Veronesi G**, Roncaioli M, Holtermann A, Krause N, Clays E, Borchini R, Grassi G, Cesana G; Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group. Exploring the interplay between job strain and different domains of physical activity on the incidence of coronary heart disease in adult men. *Eur J Prev Cardiol*. 2019;26(17):1877-1885.

- **Veronesi G**, Borchini R, Landsbergis P, Iacoviello L, Gianfagna F, Tayoun P, Grassi G, Cesana G, **Ferrario MM**; Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group. Cardiovascular disease prevention at the workplace: assessing the prognostic value of lifestyle risk factors and job-related conditions. *Int J Public Health*. 2018;63(6):723-732.

- **Ferrario MM**, Roncaioli M, **Veronesi G,** Holtermann A, Clays E, Borchini R, Cavicchiolo M, Grassi G, Cesana G; Cohorts Collaborative Study in Northern Italy (CCSNI) Research Group. Differing associations for sport versus occupational physical activity and cardiovascular risk. *Heart* 2018;104(14):1165-1172.

- **Ferrario MM, Veronesi G**, Bertù L, Grassi G, Cesana G. Job strain and the incidence of coronary heart diseases: does the association differ among occupational classes? A contribution from a pooled analysis of Northern Italian cohorts. *BMJ Open*. 2017;7(1):e014119.

- Giusti EM, **Ferrario MM, Veronesi G**, D'Amato A, Gianfagna F, Iacoviello L. Perceived work stressors and the transition to burnout among nurses in response to the pandemic: implications for healthcare organizations. *Scand J Work Environ Health*. 2024;50(3):158-167.

- **Ferrario MM**, Martire G, Gianfagna F, Lasalvia P, Cremonesi F, Tozzi M, Franchin M, Campana F, Roncaioli M, Cavicchiolo M, Borchini R, Iacoviello L, **Veronesi G**. Occupational class differences in ankle-brachial index and pulse wave velocity measurements to detect subclinical vascular disease. *Med Lav.* 2021;112(4):268-278.

- **Veronesi G**, Cavicchiolo M, **Ferrario MM**. Allostatic load as a mediator of the association between psychosocial risk factors and cardiovascular diseases. Recent evidence and indications for prevention. *G Ital Med Lav Ergon*. 2019;41(4):333-336.

- Borchini R, **Veronesi G**, Bonzini M, Gianfagna F, Dashi O, **Ferrario MM**. Heart Rate Variability Frequency Domain Alterations among Healthy Nurses Exposed to Prolonged Work Stress. *Int J Environ Res Public Health*. 2018;15(1):113.

- **Veronesi G**, Giampaoli S, Vanuzzo D, Gianfagna F, Palmieri L, Grassi G, Cesana G, **Ferrario MM**. Combined use of short-term and long-term cardiovascular risk scores in primary prevention: an assessment of clinical utility. *J Cardiovasc Med* 2017;18(5):318-324.

- Borchini R, Bertù L, **Ferrario MM, Veronesi G**, Bonzini M, Dorso M, Cesana G. Prolonged job strain reduces time-domain heart rate variability on both working and resting days among cardiovascular-susceptible nurses. *Int J Occup Med Environ Health*. 2015;28(1):42-51.

- **Ferrario MM, Veronesi G**, Chambless LE, Sega R, Fornari C, Bonzini M, Cesana G. The contribution of major risk factors and job strain to occupational class differences in coronary heart disease incidence: the MONICA Brianza and PAMELA population-based cohorts. *Occup Environ Med*. 2011 Oct;68(10):717-22.

Palais des Congrès Marrakech - Maroc
www.icoh2024.ma