Lifestyle Changes Are Needed to Eliminate Cardiovascular Diseases

Es necesario cambiar el modo de vida para hacer desaparecer las enfermedades cardiovasculares

> *"The important thing is not what they have made of us, but what we make with what they have made of us."*
> **Jean Paul Sartre**

INTRODUCTION

Until now, the health care team has been dedicated to prevent cardiovascular death with pharmacological or interventional measures, not only in secondary prevention but also -and more importantly- in primary prevention. We actively reduce the causes that generate risk but we do not eliminate them, since causes reappear in future generations because they depend on "the cause of causes": what epidemiologists call "lifestyle", but which should be better called (so as not to blame the victim) "way of life" imposed by our society, that is, the social category systematically reflecting the economic, socio-political, and cultural conditions that are stable and repeated characteristics of daily life of people and communities.

Has the time come to change the paradigm of only preventing death by adding "cardiovascular health promotion" with a change in the "way of life" of individuals and communities?

In order not to underestimate that change of approach, we should demonstrate that there is enough information associating the different ways of life with the avoidance of non-communicable diseases, and that there are indications that changes can be made in people's and communities' way of life.

Although national trends show a reduction of age-adjusted rates for cardiovascular disease (CVD) mortality, at the same time we find disturbing trends to unchanged –or even increased– prevalence of causal cardiovascular risk factors due to improper lifestyle. In Argentina, national surveys on risk factors conducted in 2005, 2009, and 2013 show that while the number of smokers tended to fall from 29.7% to 21.5% in 8 years –as in many developed countries–, those who have hypertension stayed the same (34.4%, 35% and 34.1% respectively); overweight and obesity progressively increased by 18%, from 49% to 57.9%, and diabetes increased concomitantly by 17%, from 8.4% to 9.8%. These results reveal that lifestyle behaviors worsen with physical inactivity, poor diet, and concomitant obesity and associated chronic diseases such as type II diabetes.

With our current approach, the use, cost, and unwanted side effects of procedures and medications are steadily growing, together with the number of subsequent hospitalizations for diseases such as heart failure, since patients live longer. The incidence and cost of diabetes are also growing and total health care expenses skyrocket, threatening the provision of necessary care –which is increasingly greater.

We are going to review whether there is evidence that different ways of life generating healthy practices prevent CVD development and subsequent death.

AN ORIGINAL RESEARCH

In a seminal study, Stampfer et al. studied if people's life conducts were related to preventing CVD, since its effect on risk factors was little known when considered as a set of attitudes and behavioral guidelines (1) They followed up 84,129 women who participated in the Nurses' Health Study, free from heart disease, cancer, and diabetes at the beginning of the study in 1980, and published the results at the turn of the millennium. The information on diet conditions and the rest of lifestyle behaviors were updated periodically. During the 14 year-follow-up, 1,128 major heart disease events, 296 deaths due to coronary heart disease, and 832 non-fatal myocardial infarctions were documented.

Low-risk CVD health behaviors were defined as subjects who were not currently smoking, had a body-mass index (BMI) under 25 kg/m2, consumed an average of at least half a glass of wine per day, engaged in moderate-to-vigorous physical activity (which could include brisk walking) for at least half an hour per day, and scored in the highest 40% of the cohort for consumption of a diet high in cereal fiber, marine n-3 fatty acids, with a high ratio of polyunsaturated to saturated fat, and low in trans fat and glycemic load.

Of course, each of these factors was correlated with the rest, but each independently and significantly predicted risk, even after additional adjustment for age, family history, presence or absence of hypertension or high cholesterol level, and menopausal status.

Women in the low-risk category (who made up only 3% of the population) had a relative risk (RR) of coronary events of 0.17 (95% CI, 0.07 to 0.41) as compared with all the other women, that is, a significant risk reduction of 83%. But even more importantly, the risk of coronary events in the study cohort could be reduced by 82% if all participants had adhered to lifestyle guidelines involving healthy diet, exercise, and abstinence from smoking.

The authors state that "the fact that the incidence of coronary events increases in a graded fashion as the criteria for low risk are relaxed supports the robustness of the findings, and suggests that the results do not apply solely to a selected group of particularly health-conscious persons…"

Since part of the effect of diet and lifestyle changes lead to improved lipid levels and blood pressure, adjustment for these conditions might lead to an underestimation of the way of life overall benefit.

The authors conclude that "…thus, although vigorous pharmacologic treatment of hypertension and lipid levels (when necessary) have proved to be effective, these data support the hypothesis that adopting a more healthful lifestyle could prevent a substantial majority of coronary disease events in women."

Recently, 15 years after the publication of this study, the importance of lifestyle among young women in USA has been reaffirmed. Chomistek et al conducted a prospective analysis among 88,940 women aged between 27 to 44 years at baseline in the Nurses' Health Study II from 1991 to 2011. Lifestyle factors were updated repeatedly by questionnaire. (2)

A healthy lifestyle was defined by six conditions: not smoking, a normal BMI, physical activity ≥2.5 h/week, television viewing ≤7 h/week, diet in the top 40% of the 2010 Alternative Healthy Eating Index, and 0.1 to <15 g/day of alcohol intake.

To estimate the proportion of coronary heart disease (CHD) and CVD clinical risk factors (diabetes, hypertension, and hypercholesterolemia) that could be attributed to poor adherence to a healthy diet, the population-attributable risk percentage was calculated.

During the 20-year follow-up, 456 incident CHD cases were documented. In multivariate-adjusted models, nonsmoking, a healthy BMI and a healthy diet were independently and significantly associated with lower CHD risk. Compared with women with no healthy lifestyle factors, the hazard ratio (HR) for CHD in women with 6 healthy lifestyle factors was 0.08, with an event reduction of 92%. Approximately 73% of CHD cases were attributable to poor adherence to a healthy lifestyle. It was also confirmed that there was 66% reduction of risk factors (diabetes, hypertension, and hypercholesterolemia).

These findings confirm that, even among young women, a healthy lifestyle plays an important role in the primordial prevention of CHD, and the occurrence of clinical-physiological risk factors (diabetes, hypertension, and hypercholesterolemia).

LIFESTYLE PREVENTS MYOCARDIAL INFARCTION IN MEN

The aim of the study conducted by Åkesson et al. was to examine the benefit of combined low-risk diet and healthy lifestyle practices on the incidence of myocardial infarction in men. (3)

The population-based, prospective cohort of Swedish men comprised 45 to 79-year-old men who completed a detailed questionnaire on diet and lifestyle at baseline in 1997. In total, 20,721 men with no history of cancer, cardiovascular disease, diabetes, hypertension, or high cholesterol levels were followed-up for 11 years through 2009.

Low-risk behavior included 5 factors: a healthy diet (top quintile of the Recommended Food Score), moderate alcohol consumption (10 to 30 g/day), no smoking, being physically active (walking/bicycling ≥40 min/day and exercising ≥1 h/week), and having no abdominal adiposity (waist circumference < 95 cm).

During follow-up, 1,361 incident cases of myocardial infarction were ascertained. The low-risk dietary choice together with moderate alcohol consumption was associated with a relative risk of 0.65 compared with men having 0 of 5 low-risk factors. Men having all 5 low-risk factors compared with those with 0 low-risk factors had RR of 0.14 and 86% reduction of myocardial infarction. This combination of healthy behaviors, present in 1% of men, could prevent 79% of myocardial infarction events on the basis of the study population. Men with hypertension and high cholesterol from baseline showed similar results than those without hypertension and high cholesterol.

The authors concluded that "almost 4 out of 5 myocardial infarctions in men may be preventable with a combined low-risk behavior" in this healthy population.

THE AMERICAN HEART ASSOCIATION'S METRIC OF THE 7 COMPONENTS FOR CARDIOVASCULAR HEALTH

In 2010, the American Heart Association (AHA) announced its Strategic Impact Goals to improve cardiovascular health of all Americans with a positive approach for preventing CVD. The AHA stated 7 concepts, 4 health behaviors and 3 physiological risk factors, to define cardiovascular health: smoking status, BMI, dietary content, participation in physical activity, and levels of blood pressure, blood glucose, and total cholesterol. To encompass the entire spectrum of cardiovascular health (from optimal to uncontrolled levels), each metric has 3 clinically based strata defined as ideal, intermediate, and poor. (4)

Lloyd-Jones proposes a global score by stating that "longitudinal cohort studies have the potential to look at individual changes in the metrics -for better or for worse- and the effect on outcomes. For example, a simple scoring system with 0 points awarded for poor level, 1 point for intermediate level, and 2 points for ideal level may be a good starting point to monitor individual levels and changes in cardiovascular health distribution of the population, and to analyze the results. To be sure, this simple algorithm of scores per points ignores the effect of the differential influence of risk covariates, but it can be useful given that the goal is to monitor and not to develop a risk score for clinical use." (Diagram 1) (5)

The incidence of "ideal cardiovascular health" defined by the AHA and the capacity to prevent CVD incidence were analyzed in two cohorts.

Folsom et al. analyzed the 7 cardiovascular health metrics proposed by the AHA -which includes the distribution of 4 common health behaviors and 3 traditional physiological risk factors- in a large study of American adults belonging to the Atherosclerosis Risk in Communities (ARIC) cohort. Participants were aged 45 to 65 years, and the prevalence of ideal cardiovascular health was estimated from 1987 to 1989 with the corresponding incidence rates of CVD (combined endpoint including fatal CHD, heart failure, myocardial infarction, and stroke). (6)

Among 12,744 participants initially free of CVD, only 0.1% had ideal cardiovascular health (all the 7 metrics with ideal level), 17.4% had intermediate cardiovascular health (at least 1 of the 7 metrics with intermediate level), and 82.5% had poor cardiovascular health (at least 1 of the 7 metrics with poor level). The CVD incidence rate since 2007 showed a graded relationship with the ideal, intermediate, and poor categories and with the number of ideal health metrics

present; the rates of CVD were one tenth of those with 6 ideal health metrics (3.9% per 1,000 person-years) compared with 0 ideal health metrics (37.1% per 1,000 person-years).

Individuals with the 7 cardiovascular health metrics had no CVD events during almost 20 years of follow-up.

These data suggest that most cardiovascular events are preventable, or at least can be delayed to a later stage in life, by implementing a few basic cardiovascular health parameters. These findings also provide clear evidence for the independent relevance of both conditions: the health behaviors and the physiological cardiovascular risk factors.

Lifestyle must be considered as a major independent cardiovascular risk factor, since the presence or absence of an optimal quality diet, physical activity, obesity and smoking habits are strong predictors of a gradual difference of CVD risk, even among individuals who have (untreated) blood pressure <120/80 mm

Chart 1. AHA metric of the 7 cardiovascular health components

			Lloyd-Jones Score
1. Current smoking	Ideal	Never or quit >12 months	2
	Intermediate	Former ≤ 12 months	1
	Poor	Current smoking	0
2. BMI	Ideal	< 25	2
	Intermediate	25-29.9	1
	Poor	> 30	0
3. Physical activity	Ideal	moderate ≥ 2,5 h/week or vigorous ≥ 1¼	2
	Intermediate	moderate 1 at < 2,5 h/week or vigorous 1 at < 1¼	1
	Poor	None	0
4. Healthy diet	Ideal	4 to 5 components	2
	Poor	1 to 3 components	1
	Poor	0 to 1 components	0
5. Total cholesterol	Ideal	< 200 mg/dL (no treatment)	2
	Intermediate	< 200 mg/dL (treated) or 200-239 mg/dL	1
	Poor	≥ 240 mg/dl	0
6. Blood pressure	Ideal	< 120/< 80 mm Hg (no treatment)	2
	Intermediate	< 120/80 mm Hg (treated) or systolic 120-139 mm Hg or diastolic 80-89 mm Hg	1
	Poor	systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg	0
7. Fasting glucose	Ideal	< 100 m/dL (no treatment)	2
	Intermediate	< 200 mg/dL (treated) or 200-239 mg/dL	1
	Poor	≥ 126 mg/dl	0
ADDENDUM			
The Healthy Diet Score (range 0 - 5) assigning 1 point per each component			
Fruits and vegetables		≥ 4.5 coffee cups/d	1
Fish		≥ 2 servings/wk (100 g)	1
Whole grains rich in fiber		≥ 3 servings/d (30 g)	1
Sodium		< 1500 mg/d	1
Sugar-sweetened beverages		≤ 1 liter/wk	1

AHA: American Heart Association. BMI: Body mass index.

Hg, (untreated) total cholesterol <200 mg/dl, and (untreated) fasting blood glucose <100 mg/dl.

It is possible that the true effect of both health behaviors and physiological risk factors on CVD risk were substantially underestimated in this analysis, since it fails to consider measuring errors and changes from baseline measures during 20 years of follow-up.

Another study by Yang Q. et al. used data from the National Health and Nutrition Examination Survey (NHANES) that represented the USA population. (7) The purpose was to examine time trends in cardiovascular health metrics and to estimate associations and population-attributable fractions of these metrics in relation to all-cause and CVD mortality risk.

This study was conducted on a nationally representative sample of 44,959 US adults (≥20 years) using data from the 1988-1994, 1999-2004, and 2005-2010 NHANES and the NHANES III Linked Mortality File, and as measure of the main results all-cause, CVD and ischemic heart disease (IHD) mortality.

Few participants met all 7 cardiovascular health metrics, only 2.0% (95% CI 1.5-2.5) in 1988-1994, and 1.2% (95% CI 0.8-1.9) in 2005-2010.

Among NHANES III participants, all-cause deaths were 2,673, 1,085 for CVD, and 576 for IHD during a median follow-up of 14.5 years.

Among participants who met 1 or fewer cardiovascular health metrics compared with those with 6 or more metrics, age- and sex-standardized absolute mortality risk was 14.8 (95% CI, 13.2-16.5) deaths per 1,000 person-years for all-cause mortality, versus 5.4 (95% CI 3.6-7.3); CVD mortality was 6.5 (95% CI 5.5-7.6) versus 1.5 (95% CI 0.5-2.5) and IHD mortality was 3.7 (95% CI 2.8-4.5) versus 1.1 (95% CI 0.72-2.0).

Risk reduction (adjusted HR) was 51% for all-cause mortality, 76% for CVD mortality, and 70% for IHD mortality. Adjusted population-attributable fraction was 59% for all-cause mortality, 64% for CVD mortality, and 63% for IHD mortality.

The authors conclude that meeting a greater number of cardiovascular health metrics was associated with a lower risk of total and CVD mortality, but the prevalence of meeting all 7 cardiovascular health metrics was low in the study population. (7)

Risk reductions were similar for older age, sex, race/ethnicity, and educational attainment. Having 6 or more ideal metrics was particularly associated with avoidance of premature CVD death. As observed in other analyses, the prevalence of having 7 factors at ideal levels was < 2%, and remained low in the last 20 years in USA.

IS LIFESTYLE OR GENETICS THE CAUSE OF CAUSES OF PHYSIOLOGICAL RISK FACTORS?

The question: Is there an association between "ideal cardiovascular health" and "biomarkers?" begins to be answered by V. Xanthakis et al., (8) by relating the AHA Cardiovascular Health score (CVH score) with circulating biomarkers, prevalent subclinical CVD,

and incidence of CVD in 2,680 Framingham Offspring Study participants (mean age 58 years; 55% women). The first thing is that an ideal CVH score (nonsmoking status, ideal BMI, regular physical activity, healthy diet, and an optimal profile of serum cholesterol, blood pressure, and glucose; 1 point for each), after adjusting for age and sex, was associated with higher circulating concentrations of natriuretic peptides (N-terminal pro-atrial natriuretic peptide and B-type natriuretic peptide) and lower blood concentrations of plasminogen activator inhibitor-1, aldosterone, C-reactive protein, D-dimer, fibrinogen, homocysteine, and growth differentiation factor-15 levels (p < 0.001 for all variables).

The second thing is that lower odds of subclinical disease (defined as ≥1 of the following: increased carotid intimal-media thickness or stenosis, left ventricular hypertrophy by ECG or echocardiography, left ventricular systolic dysfunction, microalbuminuria, and a reduced ankle-brachial index) were found, with OR of 0.74 per 1 unit increase in the CVH score.

Finally, the incidence of CVD was inversely associated with the CVH score (adjusted for age and sex) with a risk reduction of 23% by 1 unit increase in the CVH score, which was slightly attenuated upon adjustment for biomarkers and subclinical disease (RR 13%; 95% CI 3.0-22).

In this prospective community-based study, the inverse association between an ideal CVH score and CVD incidence was only partly attributable to its favorable impact on CVD biomarker levels and subclinical disease. To a large extent, this is due to the significant direct impact of lifestyle, not mediated by known biological mechanisms.

What do we know about the magnitude of the independent effect of adherence to a healthy lifestyle and interaction with genetics?

Khera et al (9), using a polygenic score of 50 single-nucleotide polymorphisms in the DNA sequence, quantified genetic risk for coronary artery disease in three prospective cohorts (ARIC, WGHS, MDCS) including 51,425 participants, and 4,260 additional participants in the cross-sectional BioImage Study. The authors also determined adherence to a healthy lifestyle among the participants using a scoring system consisting of four factors: no current smoking, BMI <30, regular physical activity at least once a week, and a healthy diet. The primary end point was a composite of coronary artery disease events that included myocardial infarction, coronary artery revascularization, and death from coronary causes.

A CVD risk gradient was noted during follow-up, across quintiles of genetic risk. The relative risk was 91% higher among participants at the top quintile than among those at the bottom quintile. Each of the four healthy lifestyle factors was associated with a substantially lower risk of CVD.

Participants with an unfavorable lifestyle (no or only 1 healthy lifestyle factor) had higher rates of

baseline hypertension and diabetes, a higher BMI, and less favorable levels of circulating lipids than did those with a favorable lifestyle (at least 3 of the 4 healthy lifestyle factors).

Even more interestingly, within each category of genetic risk, lifestyle factors were strong predictors of coronary events. Adherence to a favorable lifestyle, as compared with an unfavorable lifestyle, was associated with a 45% lower RR among participants at low genetic risk, 47% lower RR among those at intermediate genetic risk, and also 46% lower RR among those at high genetic risk. Among participants at high genetic risk, the standardized 10-year CVD rate was 10.7% among those with an unfavorable lifestyle and 5.1% among those with a favorable lifestyle in the ARIC cohort, similar to those in other cohorts.

The cross-sectional analysis from the BioImage Study showed that both genetic and lifestyle factors were associated with coronary artery calcification.

This study shows that even in high genetic risk categories, adherence to a healthy lifestyle was associated with a significantly decreased risk of both clinical coronary events and subclinical burden of CVD, which emphasizes that a healthy lifestyle is beneficial for everyone, regardless the type of genetic risk.

ARE THERE POPULATION EVIDENCES THAT A HEALTHY LIFESTYLE PREVENTS CARDIOVASCULAR DISEASE?

A recent cross-sectional cohort study about the occurrence of coronary artery disease among South American indigenous people from Tsimane, in the Bolivian Amazon, was conducted by Kaplan et al. (10)

The purpose of this study was to better understand the association between pre-industrial lifestyle and low prevalence of coronary artery disease risk factors, examining the Tsimane, a Bolivian population living a subsistence lifestyle of hunting, gathering and fishing, with few cardiovascular risk factors, but high infectious disease burden.

Coronary atherosclerosis was assessed by coronary artery calcification scoring done with non-contrast CT scan in 750 self-identified Tsimane adults >40 years of age and were compared with 6,814 participants from the Multi-Ethnic Study of Atherosclerosis (MESA). Eighty-five percent of the Tsimane population had no coronary artery calcification (score 0), 13% had mild calcification scores (1–100), and 2% had calcification scores higher than 100; in contrast, the MESA cohort showed 14% with score 0, 36% with score between 1 and 100, and 50% with score >100).

Calcifications increased with age in both populations, but while significant calcifications (>100) at 40-44 years of age were 1% for the Tsimane and 6% for the MESA populations, in the following decades, the increase was greater in MESA than in Tsimane participants, reaching 51% at 75-84 years versus 8% in the Tsimane group. Compared with the MESA study, a 28-year delay was observed before the Tsimane group reached a calcification score > 100.

Conventional risk factors were very low in the Tsimane group: BMI >30 in only 6%, few (5%) with blood pressure ≥140/90 mmHg, none (0%) with total cholesterol >240 mg/d, and none (0%) with blood glucose levels >125 mg%; however, ultrasensitive C-reactive protein was >3.0 mg/dL in 51% of participants, due to the multiple infections they had.

In a sample of 50 adult deaths in the last 5 years, verbal autopsy researchers could only identify a potential case of death due to myocardial infarction. A high inflammatory burden was also observed in this study, measured by erythrocyte sedimentation rate, interleukin 5, interleukin 10, C-reactive protein (CRP), white blood cell count, and monocyte count, with low prevalence of coronary artery calcification for all inflammatory markers in a population with the lowest rate of coronary events in the world.

"These findings suggest that coronary atherosclerosis can be avoided in most people by achieving a lifetime with very low LDL, low blood pressure, low glucose, normal BMI, no smoking, and plenty of physical activity."

In an editorial, Koopman and Kuipers comment that while the literature shows that atherosclerosis begins and progresses with age in healthy young adults, these findings suggest that atherosclerosis diminishes "when a sedentary lifestyle is absent and cardiovascular disease remains subclinical. Atherosclerosis seems to depend on age and is inherent to ageing. Yet its extent, and hence the onset of clinical cardiovascular disease, depends on lifestyle." (11)

Do we have evidence that the occurrence and persistence of a healthy lifestyle in young adults determines a low cardiovascular disease risk profile in middle age?

Liu et al (12) express that it is known that a low cardiovascular disease risk profile (untreated cholesterol <200 mg/dL, untreated blood pressure <120/<80 mm Hg, never smoking, and no history of diabetes mellitus or myocardial infarction) in middle age is associated with markedly better health outcomes in older age, with a substantially lower CVD rate for the rest of life, (13) but in fact few middle-aged adults have this low risk profile. Therefore, the authors examined whether adopting a healthy lifestyle throughout young adulthood is associated with a low CVD risk profile in middle age.

A sample of the Coronary Artery Risk Development in (Young) Adults (CARDIA) study was used, consisting of 3,154 black and white participants, 18 to 30 years of age at year "0" (1985–1986) who attended the year 0, 7, and 20 follow-up examinations. Healthy lifestyle factors defined in the 3 examinations at years 0, 7, and 20 included: BMI <25, no or moderate alcohol intake (up to 15 g/d for women and 30 g/d for men), highest 40% healthy diet score, highest 40% physical activity score, and never smoking.

Mean age at baseline (25 years) and percentage of women (56%) were comparable across groups defined

by number of healthy lifestyle factors. The age-, sex-, and race-adjusted prevalence of low cardiovascular risk profile at year 20 of follow-up were 3.0%, 14.6%, 29.5%, 39.2%, and 60.7% for people with 0 or 1, 2, 3, 4, and 5 healthy lifestyle factors, respectively (p for trend <0.0001), and similar graded relationships were observed for each sex and race group.

As might be expected, the percentage of black participants was higher and the average level of education was lower among those with fewer number (0 to 1) of healthy lifestyle factors. Also, their levels of systolic blood pressure, low-density lipoprotein cholesterol, and fasting blood glucose were higher at baseline, and there were a marked number of smokers, when the participants were on average 25 years of age.

Low CVD risk profile at year 20 of follow-up was only 2.1% with 0-1 healthy lifestyle factors and up to 64% with 5 factors, and the OR increased 75 times.

The prevalence of low-risk profile ranged from 53.8% for those who had 4 or 5 healthy lifestyle factors at all three time points to 13.6% for those who had <4 healthy lifestyle factors at all three time points. It was slightly above 37% for those that stopped having it at year 20, but it was the same as those who did not have it and it only appeared at the end in the year 20 (when the average age was 45 years), suggesting that healthy changes over the 20-year follow-up improve outcomes, and that giving up a healthy lifestyle worsens outcomes. Even more, the prospective association between a greater number of healthy lifestyle factors and the low CVD risk profile was also consistent among people with family history of myocardial infarction.

The authors conclude that "Clearly, a broad array of public health and public policy strategies involving schools, communities, state and governmental agencies, healthcare systems, and private organizations will be needed to address the societal problems underlying the loss of the low risk profile from young adulthood to middle age. Such policies should be designed to improve the likelihood that individuals can make healthier choices in terms of lifestyles that are associated with long-term improvements in healthy longevity and reduction in healthcare costs.

To achieve these goals, it will be critical to implement public health and individualized approaches at young ages to drastically increase the prevalence of a low CVD risk profile in the population." (12)

Daviglus et al. documented in the Chicago Heart Study that low cardiovascular risk in middle-age was associated with lower Medicare costs for older persons (14) and also in the last year of life. (15)

As Appel editorializes, "Efforts must now focus on interventions that assist individuals and populations in achieving and sustaining cardiovascular health, which hopefully will become the default rather than the exception." (16)

It is known that in the early 1970s, coronary heart disease mortality in Finland was the highest in the world, and was particularly high in the eastern part of the country. The North Karelia Project, the first large community-based CVD prevention program, was established in 1972 to reduce the extremely high CVD mortality through behavioral change and reduction of the main CVD risk factors among the whole population of North Karelia, the easternmost province of Finland. (17) During the 40-year period from 1972 to 2012, there was a marked decline in smoking prevalence (men from 52.6% to 29.3%), serum total cholesterol (men 261.8 mg/dL to 210.3 mg/dL, women from 258.7 mg/dL to 204.9 mg/dL), and systolic blood pressure (men from 147.1 to 135.9, women from 149.2 to 129.1). From the early 1970s to 2012, CVD mortality decreased by 82% (from 643 to 118 per 100,000) among working-age (35 to 64 years) men; among working-age women, the decline was 84% (from 114 to 17 per 100,000). During the first 10 years, changes in those three risk factors explained mortality reduction; since the mid-1980s, mortality reduction has increased (almost doubled) compared with mortality reduction expected as the result of low risk factors, indicating a direct impact of behavioral health changes non-mediated by known risk factors.

In the early 1970s, premature CVD mortality (35 to 74 years) was 37% higher among Eastern Finnish men, compared with men in Southwestern Finland. During the last 40 years, premature CVD mortality declined markedly in both areas, but the decline was larger in Eastern Finland and the mortality gap between the two areas nearly disappeared, indicating the absolute success of the population program in the community. (17)

CONCLUSIONS

After this review, it is evident that "lifesyle" of people and communities determine the occurrence of CVD in adult age and the subsequent premature death.

It is also significant that the effect of healthy life behaviors (never-smoking, no or moderate alcohol intake, regular physical activity, healthy diet) is only in part mediated by the reduction of the main physiological risk factors (serum cholesterol, blood pressure, and glucose levels).

And the reduction of the CVD risk profile and CVD premature death is marked, more than 80%, and this is reflected in a frank and similar risk reduction attributed to the population, resulting in a striking epidemiological effect. And it is also evident that the effect is similar in both men and women, in different ethnicities, in people with or without family history of CVD, and the same effect is even maintained in those groups with higher genetic susceptibility to vessel diseases.

The small great detail that is missing is the national and global implementation of a social policy coordinated with a health policy, at the population, community, and people level, extending the adoption of healthy behaviors and reduction of risk factors, reach-

ing the homes of people with health workers in the community, integrating them to the health care system and preventing the main causes responsible for CVD epidemics, so that it becomes a historic memory -as was the case with typhus, smallpox, polio, and is currently happening with measles.

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