# Fruit and Vegetable Concentrate Supplementation and Cardiovascular Health: A Systematic Review from a Public Health Perspective

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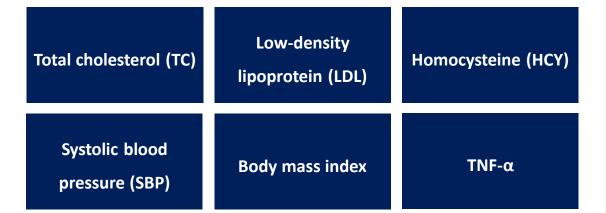
# STUDY OBJECTIVES

To perform a systematic review aimed at assessing the effect of fruit and vegetable (FV) concentrate supplementation on selected physiological parameters that are considered relevant risk factors for the development of cardiovascular diseases (CVDs).

# **Main study outcome:**

Ten-year projection of coronary heart disease (CHD) prevalence and direct cost for the United States following FV concentrate supplementation or no supplementation.

## Physiological parameters ('surrogates') of interest





# **METHODOLOGY**

The systematic review included studies published in English, until 22 June 2018 meeting all of the following criteria.

Participants	General population aged ≥18 years of both sexes			
Interventions	Supplementation with fruits, vegetables or fruit and vegetable concentrates			
Comparisons	Comparisons Placebo or no treatment			
Outcomes	Total cholesterol, low-density lipoprotein, plasmatic homocysteine, systolic blood pressure, body mass index			
Study design	Interventional			

This project was conducted under the direction of the Unit of Biostatistics, Epidemiology and Public Health,

Department of Cardiac, Thoracic, Vascular Sciences and Public Health, University of Padova, Italy; in collaboration

with the School of Medicine, University of Colorado, Aurora, CO, USA.



# **RESULTS**

- 13 articles meeting the inclusion criteria were identified and included in the review
  - Encapsulated fruit and vegetable (FV, Juice Plus+®, n=7)
  - Artichoke leaf juice (n=1)
  - Jerusalem artichoke juice (n=1)
  - Orange juice (n= 1)
  - Fruit and vegetable drink (n= 1)
  - Cherry juice (n= 1)
  - Fruit juice (n= 1)



Supplementation with a juice powder concentrate and exercise decrease oxidation and inflammation, and improve the microcirculation in obese women: randomised cort-- " - 1 - 1 - 1 - 1

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Institute of Nutrient Research and St portchinurviePlus. Centre for Ind FH JOANNEUM, University of Applied Institute of Laboratory Sciences, Dr O

nown that an encapsulated fruit/berry/ve clox biology, low-grade inflamenation ar tion with FBV or placebo, and a single ulation in forty-two obese pre-m

become a serious public health concer-habits coupled with a sedentary lifesty and microcirculatory dysfunction itrosen species and pro-inflamma

esponding author: Dr M. Lamprecht, fa

Original Research

### Effects of Encapsulated Fruit and Vegetable Juice Powder Concentrates on Oxidative Status in Heavy Smokers

Cristina Novembrino, PhD, Giuliana Cighetti, PhD, Rachele De Giuseppe, BS, Luisella Vigna, MD, Federica de Liso, BS, Marco Pellegatta, MD, Dario Gregori, PhD, Rita Maiavacca, MD, Fabrizia Bamonti, PhD

Dipartimento di Scienze Mediche (C.N., F., (R.D.G.), Università degli Studi di Milan-(L.V., M.P.), Laboratorio Patologia Clinic Maggiore Policlinico (C.N., F.d.L., F.B., R.

Key words: cigarette smoking, oxidative

lipoprotein (LDL) oxidat heavy smokers (>20 cigarettes after 3 months' supplements and total (tMDA - fMDA +

decrease in total cholesterol i slight increase in bMDA cor

### INTRODUCTION

developed countries, with a significant pu cancer deaths, and the risk of dying from lun

Journal of the American College of Nutriti

### Effect of Supplemental Phytonutrients on Impairment of the Flow-Mediated Brachial Artery Vasoactivity After a Single High-Fat Meal

Gary D. Plotnick, MD, FACC,\* Mary C. Corretti, MD, FACC,\* Robert A. Vogel, MD, FACC,\* Robert Hesslink, Jr., ScD,† John A. Wise, PhD†

Baltimore, Maryland; and San Marcos, California

BACKGROUND Ingestion of a high-fat meal impairs flow-mediated vasodilation of the brachial artery for at lingsstoon of a night rat metal ampairs now "incustaced vasculations of site of actual and surely not a least 4 hi, however, co-ingestion of vitamin antioxidation or a green salad has been shown to prevent this effect. Flow-mediated brachial artery reactivity test (BART) both before and 3 h after a 900 caloni-

Powe modified brachial attery reactivity text (BART) both before and 3.1 after a 900 calorie 300 g far and was execution if 38 blands by sometime ring 36 4 at 10 years. Subjective was a simple of the power of the

treated with supplements, concentrations of serum intrate/minte is  $114 \pm 62 \mu m/1$  (p < 0.02). CONCLUSIONS Duily injection of modest amounts of a fruit/vegetable inice cor

Lutty ingertion of modest amounts of a fruit/vegetable juice concentrate with or without
adjunctive phytoeutrient supplementation can reduce the immediate adverse impact of
high-fat meals on Braw-mediated vesacritivity and increase intraviorities Bolso donestration. (J Am Coll Cardiol 2003;41:1744–9) © 2003 by the American College of Cardiology
Foundation

with reduced risk for coronary heart disease and ischemic stroke in large prospective case-control studies (1-5). The mechanisms by which fruit and ovegetable consumption achieves this benefit remain to be established. They can rovide a substantial ration of dietary potassium and soluble

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fiber and are typically rich in a range of antioxidant phytonutrients. Previous studies show that antioxidant vi-tamins—notably C and E—can often exert a favorable effect on endothelial function (6-11). In particular, they appear to help preserve the endothelium's capacity to generate bioactive nitric oxide (NO) in various pathogenic ircumstances that tend to impair this activity. Nitric oxide acts to stabilize platelets, promote vasodilation, inhibit

harmful impact of endothelial oxidants on NO bioactivity, they have the potential to make an important contribution to vascular health (11)

A sudden increase in the shear stress acting on arterial endothelium induces an endothelium-dependent, NOmediated vasodilation that is susceptible to non-invasive quantitation by high-frequency ultrasound techniques (12,13). Flow-mediated vasodilation (FMV) of the brachial artery, evoked by the hyperemia that follows relief of pressure-cuff occlusion of arterial blood flow, is now com ponly measured to assess the endothelium's canacity fo generating bioactive NO in conduit arteries. This FMV is often impaired in patients expressing coronary risk factors iated with endothelial dysfunction, such as hypercho From the \*Unormory of Marghand School of Medicion, Robinson, Marghad, and 
Pleaned Romation Internation International Internation International Internation International Internation International Internation International Internat impaired for up to 4 h after the ingestion of a fatty meal,



# **MAIN RESULTS – CHD EVENTS**

- + For the prevention of CHD events in the general population, FV supplementation was found to have the strongest impact compared to other types of nutritional interventions.
- + This was followed by orange juice, cherry juice, fruit and vegetable drink, and fruit juice.
- The median estimated CHD events reduction projected to 2025, achieved by FV supplementation (through the mediation of HCY) is 62.41 millions events.

	FV	Orange juice	Fruit and vegetable drink	Cherry juice	Fruit juice
НСҮ	(55.7 <b>, 62.41</b> , 81.12)	<b>0</b> . <b>1</b> .	(-1.35, 1.47, 9.4)	7,	
TC	(29.97, <b>36.26</b> , 53.72)	(7.04, 21.08, 42.86)	(4.86, 11.54, 28.72)	(13.76, 21.01, 37.24)	(-7.46, 8.62, 46.75)
LDL	(0.17, <b>0.61</b> , 1.9)	(-0.77, 4.9, 20.7)	(-0.35, 2.32, 10.2)		(-1.71, 2.66, 15.16)
SBP	(6.47, <b>8.87</b> , 16.17)		(-5.89, 2.33, 24.57)	(2.87, 11.88, 35.46)	

**TNF-** $\alpha$  (1.17, **1.85**, 3.67)

Table 1: Estimated effect in terms of the absolute numbers of coronary heart disease (CHD) events reduction for different supplementation regimes in the general population, projected in 2025. Reported events are expressed in millions of events (95% C.I. lower bound; median; 95% C.I. upper bound).



# **MAIN RESULTS – COST REDUCTION**

- + For the CHD treatment related cost savings in the general population, FV supplementation was found to have the strongest impact compared to other types of nutritional interventions.
- This was followed by orange juice, cherry juice, fruit and vegetable drink, and fruit juice.
- The median estimated direct cost reduction for the treatment of CHD, achieved by FV supplementation (through the mediation of HCY) is \$109.76 bn.

	FV	Orange juice	Fruit and vegetable drink	Cherry juice	Fruit juice
HCY	(96.17, <b>109.76</b> , 153.44)		(-2.4, 2.55, 17.02)		
тс	(52.16, <b>63.65</b> , 100.01)	(12.37, 37.11, 78.92)	(8.43, 20.31, 52.57)	(24.34, 36.8, 69.27)	(-13.07, 15, 84.05)
LDL	(0.29, <b>1.07</b> , 3.44)	(-1.36, 8.69, 37.37)	(-0.63, 4.06, 18.37)		(-3.05, 4.65, 27.24)
SBP	(11.34, <b>15.54</b> , 29.6)		(-10.29, 4.15, 44.62)	(5.05, 20.71, 64.77)	
TNF-α	(2.05, <b>3.23</b> , 6.7)				

Table 2: Estimated effect in direct cost reduction for different supplementation regimes, for the treatment of coronary heart disease (CHD), in the general population, projected in 2025. Direct costs are expressed in billions of dollars (95% C.I. lower bound; median; 95% C.I. upper bound).



# **SUMMARY/CONCLUSION:**

Based on this systematic review, published in a peer-reviewed and powerful scientific journal, supplementation with an encapsulated fruit and vegetable juice powder concentrate can save:

- → Millions\* of coronary heart disease events in the general US population over 10 years
- Billions\*\* of US-Dollars for the treatment of coronary heart diseases in the general US population over 10 years





Article

# Fruit and Vegetable Concentrate Supplementation and Cardiovascular Health: A Systematic Review from a Public Health Perspective

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<sup>\*</sup>Exact numbers see Table 1

<sup>\*\*</sup> Exact numbers see Table 2