

Vascular function and metabolic health in humans

Citation for published version (APA):

Joris, P. (2016). *Vascular function and metabolic health in humans: effects of diet and weight loss*. [Doctoral Thesis, Maastricht University]. <https://doi.org/10.26481/dis.20160708pj>

Document status and date:

Published: 01/01/2016

DOI:

[10.26481/dis.20160708pj](https://doi.org/10.26481/dis.20160708pj)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

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Valorisation

VALORISATION

Valorisation

The medical, societal and economic consequences of cardiovascular disease (CVD) combined with the growing world population over the age of 60 years requires multilevel assessments and multidimensional solutions. The World Health Organization (WHO) has estimated that by the year 2050 the world population aged 60 or over will be two billion. Human ageing is associated with an increased risk of cardiovascular problems and effective intervention strategies are highly needed for the prevention or delay of CVD. The research described in the present dissertation focused on three well-defined intervention studies and two meta-analyses of intervention trials, which were specially designed to assess the specific effects of various dietary factors and weight loss on vascular function markers predicting the risk for CVD. We provided further evidence that dietary changes improve cardiovascular health based on beneficial effects on vascular endothelial function and arterial stiffness. Besides the scientific value of the research described in this dissertation, the study findings can also be presented in terms of societal and economic relevance, which is known as valorisation. Valorisation has been defined by the Dutch National Valorisation Commission as “the process of creating value from knowledge by making knowledge suitable and/or available for societal and/or economic use, and by translating that knowledge into competitive products, services, processes and commercial activities”. In other words: “How can the findings described in this thesis be translated into practice?”. The societal and economic relevance of these findings will be first addressed. The next question that needs to be addressed is how the generated scientific knowledge can be translated into practice.

Societal and economic relevance

Various vascular function markers are associated with future cardiovascular events and can also be used to demonstrate CVD benefits. We found that a single dose of beetroot juice improved the postprandial impairment in flow-mediated vasodilation of the brachial artery (FMD) after consumption of a mixed meal [reported in **chapter 3**]. In our meta-analysis described in **chapter 5**, it was estimated that each 10 kg decrease in body weight was associated with an increase of about 1% in FMD. Results from prospective epidemiological studies have suggested that the risk of CVD decreases by 8% when FMD increases by 1% [1]. In abdominally obese men, diet-induced weight-loss tended to decrease carotid-to-femoral pulse wave velocity (PWV_{c-f}) by 0.5 m/s [**chapter 6**]. A decrease of this magnitude at the population level would lead to a 7% risk reduction of CVD [2]. Furthermore, as reported in **chapter 7**, long-term magnesium supplementation in overweight and slightly obese adults improved PWV_{c-f} as compared with placebo by 1 m/s, which has been related with a 14% decrease in the risk to develop CVD [2]. The relevance of these nutritional interventions in promoting public health can thus be found in the prevention of CVD in the large part of the population that is at increased cardiovascular risk, but not yet diagnosed with disease or under medical treatment. In addition, high-risk patients such as subjects already diagnosed with

CVD may also benefit from these intervention strategies, but this warrants further studies.

Identifying effective intervention strategies to prevent or postpone conditions such as CVD associated with human aging will also have an enormous economic impact. In fact, nutritional interventions described in the present dissertation, such as oral magnesium supplementation [**chapter 7**], which can be easily achieved at low costs, could scale down medical costs, revalidation and medication, and would therefore be of significant economic relevance. This would also have a great societal impact, since CVD is the leading cause of death worldwide [3]. However, potential risks that may be associated with the consumption of dietary components described in this dissertation should also be kept in mind. For instance, concern has been raised about potential adverse effects of vitamin E supplementation. One meta-analysis indeed concluded that high-dose vitamin E supplementation may increase all-cause mortality in trials supplying daily doses > 400 IU, that involved adults with chronic diseases [4]. In another thorough meta-analysis, vitamin E given singly or in combination with other antioxidant supplements was also found to increase mortality in randomized primary and secondary prevention trials when trials with low methodological quality were excluded [5].

The various vascular function measurements described in this dissertation may also function as future screening tools to determine the specific components, either from nutritional or pharmacological origin, that will be beneficial to reduce the risk to develop CVD. Measurement of these validated vascular markers may also give physicians the opportunity in the future to early diagnose and follow the progression of cardiovascular complications. In fact, PWV_{c-f} has already been depicted as a promising future tool for cardiovascular risk prediction in clinical practice [6, 7]. This is of the great importance, as it has been shown that various treatments are more effective if they are given early in the disease process. Furthermore, more information on the development and natural progression of age-related conditions such as CVD will be provided. Overall, the present thesis provides further data on the sensitivity of various vascular markers to diet-induced changes. From industrial, academic and public health perspective, these results may be of great relevance as vascular dysfunction is a key mechanism whereby a healthy diet and healthy lifestyle improve cardiovascular health [8].

Translation into practice

The results described in this thesis have been presented at national and international conferences to colleagues inside and outside the field with the purpose to increase the awareness of the medical, societal and economic consequences of CVD and to highlight the potential impact of diet and weight loss. Results have also been discussed with experts for possible explanations or innovative ways to look at the data. For instance, experts of the industrial partners within this project have contributed to the described research projects through regular discussions at tri-annual expert meetings. Moreover, research findings have been published or submitted to international peer-reviewed scientific journals in the categories “nutrition and dietetics” and “peripheral vascular disease”.

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Published research data are therefore accessible to scientists worldwide, and will drive other research groups for further investigation with the purpose to further broaden current knowledge.

The research described in the present thesis was funded by research grant CH-001 from the Top Institute of Food and Nutrition (TIFN). TIFN is a public-private partnership between knowledge institutes, industry and government conducting strategic research in food and nutrition. Further, magnesium and placebo capsules were kindly provided by Laboratorium Medisan B.V. (Heerenveen, The Netherlands). These interactions and cooperation's are crucial for the optimal valorisation of findings extracted from scientific research. In fact, scientists have a good insight into existing knowledge from scientific publications and they can use that knowledge to design promising trials. Scientists know how to perform well-designed intervention studies and academia have state-of-the-art facilities to investigate health effects of the most promising products. On the other hand, industries focus on the innovative and practical use of research, and the translation into products that can be marketed, while the Dutch government supports science and industry to transfer scientific knowledge for the benefit of society and the economy. Close collaborations between these partners will have societal and economic impact as they facilitate both the translation of research findings into commercial products that may lead to an improvement in quality of life and the application of generated knowledge for governmental policy-making.

Research findings reported in the present dissertation should be confirmed in additional studies. The effects of dietary interventions may also differ between target groups. While we focused on the large part of the population that is at increased cardiovascular risk, but not yet diagnosed with disease or under drug treatment, future research should now broaden its focus on different target groups (e.g. subjects with the metabolic syndrome or CVD patients). Only when results are confirmed in several independent scientific trials, these study findings can be considered univocal. The generated scientific knowledge can be used by different policy makers. One group may be the Health Council of the Netherlands, which is an independent scientific advisory body informing the Dutch government and parliament on public health. Health agencies such as the Netherlands Nutrition Centre (Voedingscentrum) are valuable in providing scientific evidence-based information on healthy and safe food to the Dutch population. In addition, the European Food and Safety Authority (EFSA) is the agency of the European Union that provides highly valuable scientific advice on the use of foods and food components. EFSA protects European consumers from scientifically unfounded advice regarding healthy nutrition, which has a negative impact on nutritional science and also threatens the credibility of nutritional scientists.

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