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Health benefits of F&V consumption

Edito

The societal burden of disease due to the epidemic of cardiovascular diseases, cancer, obesity and cognitive decline – the latter in the more and more senile societies - may be contained by dietary lifestyle based on fruit and vegetables. The picture of the evidence concerning the favorable effect on health associated with fruit and vegetables consumption is further enriched by the results of the three papers commented here. CN. Armah explains that the cruciferous vegetables like broccoli may exert their cardiovascular protection through many anti-oxidant substances which include the glucoraphanin, whose content is very high in the Benefortè type with specific effect on the reduction of LDL-cholesterol. A focus is done by CE. O'Neil on apples, which are shown to be the main indicator of fruit and vegetables consumption in the American diet and as a marker of healthy eating, are associated with low prevalence of obesity, including in children. Finally, C. Feart shows that the betacarotene-rich fruit and vegetables are reported to have their beneficial effect on cognitive impairment through lutein. The consistency of the evidence of the health effects of vegetables and fruit coming from epidemiological, clinical and experimental studies is quite strong and possibly indicates that we still have some steps to go further in defining the suggested daily consumption which might be higher than the current recommendations. The variety of biological and biochemical effects also suggest that the dietary consumption of the products is the best way to preserve health.

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To know more:

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Acknowledgement to 250 contributors since 2006

June 2010 : BJ. Rolls ; JE. Obbagy; TVE. Kral; SA Tanumihardjo (Increasing F&V consumption to reduce energy intake)

July/August 2010 : I. Elmadfa ; M. Swanson; A. Branscum; E. Winkler; C Rennie (New Ideas to increase fruit and vegetable consumption)

September 2010 : N. Pearson; N. Larson; D. Neumark-Sztainer; C. Lachat and colleagues; R. Jago (Dietary patterns in adolescents)

September 2010 (special issue): C. Rowley, P. Dudley ; KI. Klepp; T. Armstrong; J. Breda ; H. Madi, F. Ben Abdelaziz (Marketing of foods and non-alcoholic beverages to children)

October 2010 : L. Hoelgaard ; I. Elmadfa, A. Meyer; J. Brug; FJB Van Duijnhoven and colleagues (F&V consumption - Socioeconomic determinants and health)

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Benefits from a diet rich in high glucoraphanin broccoli

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Dietary advice to consume fruit and vegetables (F&V) every day is largely based upon observational data from epidemiological studies that have associated diets rich in F&V with a reduction in age related chronic illness[1,2]. The lack of F&V in the diet has been recognised for many years as being a risk factor for both cardiovascular disease (CVD) and some cancers, leading to the establishment of the 5-a-day UK campaign in 1994.

Health promoting properties of glucosinolates and isothiocyanates in cruciferous vegetables

Studies with cell and animal models have suggested that health promoting properties of cruciferous vegetables, in particular, may be mediated in part by the biological activity of isothiocyanates, derived from the sulphur-containing glycosides known as glucosinolates that accumulate within this group of vegetables[2]. In a previous study performed by our group, the Diet and Vascular Health (DVH) study, it was reported that 400g of cruciferous vegetable consumption over a 12 week period led to a clinically significant reduction in cardiovascular risk factors with a reduction in absolute risk identified in a group of participants consuming a new cultivar called high glucoraphanin (HG) broccoli (p=0.03).

The reduction in risk of CVD and cancer, observed in epidemiological studies associated with the consumption of cruciferous vegetables, tends to be amongst those individuals who eat several portions per week[3,4], which is atypical of the general population. This implies that the level of isothiocyanates obtained from common dietary practices is insufficient to obtain health benefits.

A diet enriched with high HG Broccoli could reduce the risk of CVD

We have previously described the development of a novel cultivar of broccoli by conventional plant breeding that has a three-fold greater level of glucoraphanin than standard broccoli cultivars, and which delivers a three-fold greater level of the isothiocyanate sulforaphane to the systemic circulation[5,6]. The broccoli cultivars used although they are genotypically different are phenotypically the same resulting in flavour and all other sensory attributes being identical. Thus, to further explore the role of cruciferous vegetables and the potential role of glucosinolates and isothiocyanates in reducing risk of CVD, we have undertaken a dietary intervention study that will compare the effects of a diet enriched with a cultivar of standard broccoli (Parthenon) with that of a diet enriched with a commercially available cultivar of high glucoraphanin broccoli, Beneforté® broccoli.

Study design

The Broccoli and vAScular Health Study (BASH): In total 107 men and women were enrolled onto the BASH study between August 2012 and October 2013 in Reading and Norwich with 95 participants completing the study. Of the 95, 47 participants were allocated to HG broccoli and 48 to standard broccoli. Each group was asked to consume 4 portions (100g each) of their designated broccoli per week as part of their habitual diet. Blood samples were taken and blood pressure was assessed pre and post intervention.

Diet rich in high glucoraphanin broccoli reduces plasma LDL cholesterol

Participants consuming the HG broccoli had a significant reduction in plasma LDL-C compared to their own baseline level, but with no significant changes in HDL cholesterol, total cholesterol or TAG.

When data from the BASH study was combined with our previous study (DVH), the reduction in LDL-C by the HG broccoli was significantly greater (p=0.031) than that of the standard broccoli. There was no significant association between reduction in LDL-C and study, recruitment centre or sex.

The reduction in LDL-C by HG broccoli was not dependent upon baseline LDL levels (% ΔLDL-C = 5.8 – 2.6LDL-Cbaseline, r^2=2.9%, p = 0.097), in contrast to that of standard broccoli which was significantly associated (% ΔLDL-C = 18.8 – 4.8LDL-Cbaseline, r^2= 13.7%, p = 0.001). Once the data was reanalysed according to subgroups of participants with different baseline LDL-C, we observed a more moderate effect of standard broccoli at reducing LDL-C but only in participants who have higher baseline LDL-C.

In conclusion, the results of the two studies (DVH and BASH) would support the hypothesis that diets rich in broccoli reduce LDL-C, and indicate that the bioactive component is glucoraphanin. The HG broccoli reduced LDL-C by a similar amount to oat ß glucans and plant stanols. The mechanism by which this reduction occurs is likely to be due to suppression of cholesterol synthesis as opposed to suppression of cholesterol and/or bile acid absorption. This may suggest there may be additive LDL-C lowering effects through combining these different food items in the diet. This could contribute to more specific public health advice on the benefits of glucoraphanin containing vegetable consumption for CVD risk reduction.

Based on: *Armah, C. N., Derdemezis, C., Traka, M. H., Dainty, J. R., Doleman, J. F., Saha, S., Leung, W., Potter, J. F., Lovegrove, J. A. and Mithen, R. F. (2015), Diet rich in high glucoraphanin broccoli reduces plasma LDL cholesterol: Evidence from randomised controlled trials. Mol. Nutr. Food Res., 59: 918–926. doi: 10.1002/mnfr.201400863*

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Eating apples for a better diet quality and to reduce risk of obesity among children

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Increasing intake of fruit would contribute to a healthy eating pattern. The recommendation for fruit depends on age, gender, and physical activity level; and varies from 1 cup equivalent for children 2-3 years of age (years) to 2 cups equivalents for males 14-18 years. Unfortunately, most children don't meet the recommendation for fruit intake even if fruit consumption may prevent the risk of cardiovascular disease, type 2 diabetes, and some types of cancer.

Nutrient components of apples

Apples are the second most commonly consumed fruit in the United States, with 65% consumed as fresh fruit and 35% as processed apple products. Raw apples contain practically no total fat, saturated fatty acids, or sodium; and they have no cholesterol. One medium raw apple (182g) with its skin provides approximately 95 kcals, 19g total sugars, 4g dietary fiber (22% of the daily value [DV]) this makes apples an excellent source of fiber. They are also especially rich in phenolics like hydroxycinnamic acid derivatives and flavonoids.

Apple/apple product consumption assessment in the NHANES

The main aim of this study was to examine the link between diet, nutrition and health. In particular, it focused on the association between the consumption of apples, in its various forms, and diet quality. A sample of 13339 children (2-18 years) was asked to write down a 24-hour diet recall. The recall was framed by using the cycle appropriate United States Department of Agriculture (USDA) food codes (whole apples; apple sauce; 100% apple juice; total apples).

The HEI-2010 allowed to determine diet quality and component scores. We considered 12 component scores, 9 measure adequacy, three moderation. In any case, the higher the scores, the better for our health.

Apple consumption in the study population

The results showed a correlation between apple consumption and some demographic characteristics. Mexican-Americans consumed more whole apples than apple sauce, while non-Hispanic blacks were less likely to consume whole apples and apple sauce.

Approximately 26% of the population (n = 3482) consumed apples in various forms including whole apples, which was the most consumed form (14%), and other apple products such as apple sauce (5%) and 100% apple juice (12%). Mean intake of any apple products was 222.2 ± 3.9 g with 143 ± 3.8 g from whole apple.

Apple consumption leads to higher HEI scores and lower prevalence of obesity

Consumers of any apple product had higher total HEI-2010 scores than non-consumers, even if these scores were relatively low (Figure 1).

Figure 1:
Healthy Eating Index scores of children (2-18 years of age) participating in NHANES 2003-2010.

	HEI scores	
	Apple consumers	Non consumers
Apple products	50.4 ± 0.4	41.9 ± 0.3
Whole apples	52.5 ± 0.5	42.7 ± 0.3
Apple sauce	52.1 ± 0.8	47.2 ± 0.4
100 % apple juice	51.4 ± 0.6	46.5 ± 0.4

Apple products and whole apple consumers had lower BMI z-scores than non-consumers (0.4 ± 0.04 v 0.5 ± 0.03 and 0.3 ± 0.1 v 0.5 ± 0.02, respectively) and had a lower prevalence of obesity. Only total apple product had a lower prevalence of overweight or obesity. No significant differences of weight or adiposity measures were found between apple sauce and apple juice consumers as compared with non-consumers. Finally, children who consumed total apple products (25%) and wholes apples (30%) were less likely to be obese than non-consumers.

Including apples in the children's diet to meet the fruit recommendations

Total apple products and whole apples consumption should be encouraged as it contributes to the overall diet quality.

This epidemiologic study is the first one, to our knowledge, that examined the association between apple products and weight. More research has to be conducted to explore the contribution of all fruit forms as a part of a healthy diet.

Based on: *O'Neil CE, Nicklas TA, Fulgoni VL., III Consumption of apples is associated with a better diet quality and reduced risk of obesity in children: National Health and Nutrition Examination Survey (NHANES) 2003–2010. Nutr J. 2015; 14:48*

Higher lutein levels and lower risk of dementia

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Nutrition as a promising strategy to post-pone cognitive decline

In the field of prevention of age-related cognitive decline, several nutritional strategies have been explored and diets rich in plant foods, i.e. fruits, vegetables, legumes, nuts and cereals, such as the Mediterranean diet, seem highly promising. However, the contribution of each class of nutrients to the protective effects of plant foods on cognition is still poorly understood. Vitamins C and E, polyphenols and carotenoids seem the most interesting nutrients although mixed results have been reported regarding the risk of all-cause dementia or Alzheimer's Disease (AD) to date.

Biological nutrient status as a surrogate of nutrient intake

Circulating nutrient status is affected by dietary intake, but also by inter-individual differences in bioavailability and metabolism. Surprisingly, few studies have yet investigated the link between circulating nutrients, including carotenoids, and age-related cognitive decline or dementia risk. Case- control studies persistently reported lower circulating levels of carotenoids among demented people, while cross-sectional studies suggested that appropriate levels of beta-carotene, lycopene, lutein, and/or zeaxanthin were associated with better cognitive performances among elderly people. Because of the long prodromal phase of dementia, only longitudinal studies with relatively long follow-up could ensure that the observed exposure precede the outcome. To date, few longitudinal studies of the association between plasma carotenoid concentrations and cognitive decline have been published and showed conflicting results[1-2].

Carotenoids concentrations and risk of dementia: epidemiological evidence from the Three-City-Bordeaux study

Recently, we aimed to focus on the risk of all-cause dementia and AD over 10 years in relation to plasma concentrations of various carotenoids.

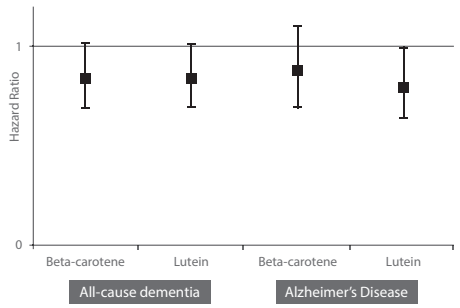
The study sample consisted of 1092 participants from the Three-City-Bordeaux study, an ongoing prospective cohort study of vascular risk factors of dementia. These participants, free of dementia at baseline, aged 74.4 y on average, have been re-examined every two years over 10 years. A clinical exam allowed to perform the diagnosis of dementia / AD. The baseline concentration of plasma carotenoids (beta-carotene, alpha-carotene, lycopene, lutein, zeaxanthin and beta-cryptoxanthin) was determined using high-performance liquid chromatography, by DSM Nutritional Products.

In both incident cases of dementia and in control participants, two-thirds of plasma carotenoids were composed of carotenes, mainly beta-carotene. Lutein and beta-cryptoxanthin were equally represented among total xanthophylls (44% of each on average).

After adjustment for socio-demographic, genetic and clinical variables, the plasma total carotenoids, beta-carotene, total xanthophylls and zeaxanthin concentrations were not individually statistically associated with the risk of all-cause dementia. Regarding plasma lutein, a trend for an inverse association was observed: higher lutein concentrations were associated with a borderline reduced risk of dementia (up to 16%) (Figure 1). Regarding the etiology, only an increase of plasma lutein was significantly associated with a 21% lower risk of AD in fully adjusted analyses (Figure 1).

Figure 1:
Risk of all-cause dementia and Alzheimer's Disease over 10 years, based on beta-carotene and lutein concentrations, among Three-City-Bordeaux participants

Square: Hazard Ratio. Lines: upper and lower limits of 95% Confidence Interval



In this study, we reported the specific importance of lutein, among all carotenoids, assessed as a biomarker of consumption. The potential underlying mechanisms of action of carotenoids more generally may be due to their antioxidant properties although other mechanisms, such as anti- inflammatory functions, the modulation of functional and structural properties of synaptic membranes, regulation of cell growth, enhancement of gap junctional communication, could also partly contribute to their brain beneficial biological actions[3-4]. Moreover, several data have suggested that lutein and zeaxanthin were important contributors of the maintenance of brain functions3. Lutein and zeaxanthin are preferred carotenoids in the human brain, contributing to more than two thirds of total brain carotenoids, are mainly present in regions vulnerable to AD and a potential anti-amyloid effect of beta-carotene has even been suggested.

A step forward

In the field of carotenoids, few interventional studies have examined the preventive role of lutein or beta-carotene in mild cognitive impairment and AD, and provided mixed results to date[5-6]. The replication of the associations observed in our study is warranted, especially using biomarkers. Nevertheless, data about dietary intake of F&V have also underlined that a higher intake of vegetables, notably green leafy vegetables, but not fruits, was associated with a decreased risk of dementia or cognitive decline[7]. A specific dietary pattern, including explicitly green leafy vegetables, has even been proposed as a dietary model that provides better protection against dementia[8]. To date, the take-home message is that further researches about dietary habits are still required for improving the brain health of older adults before elaborating dietary recommendations.

Based on: *Feart C, Letenneur L, Helmer C, Samieri C, Schalch W, Etheve S, Delcourt C, Dartigues JF & Barberger-Gateau P (2015) Plasma Carotenoids Are Inversely Associated With Dementia Risk in an Elderly French Cohort. J Gerontol A Biol Sci Med Sci. (in press)*

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