



Type 2 diabetes: importance of F&V

Fresh fruit and vegetables – underused option for prevention and “treatment” of type 2 diabetes

Three summary reports in this issue emphasize the benefit of fresh fruit and vegetables (F&V) in the prevention and “treatment” of type 2 diabetes. Franziska Jannasch and co-authors summarize the main results of their systematic review and meta-analysis on different dietary patterns in prevention of diabetes. Three different patterns had beneficial impact; Mediterranean type, DASH (*Dietary Approach to Stop Hypertension*) and AHEI (*Alternative Healthy Eating Index*) diets were associated with 13 to 20 % reduction of diabetes. Intriguingly, both low and high fat (Mediterranean type diet) diets seem to decrease the risk of type 2 diabetes. These observational findings are in line with long-term follow results obtained from type 2 diabetes prevention trials where diet has been moderately low in fat but counselling encouraged increasing use of fruit, vegetables and whole grains.

In a large Chinese study published recently by Huaidong Hu, fresh fruit consumption was associated with 12% lower risk of incident diabetes in people who were non-diabetic at the onset of the study. Furthermore, a lower risk of total mortality, cardiovascular diseases and microvascular complications was observed among diabetic patients who used fresh fruit regularly at the onset of follow-up. Curiously, patients with known diabetes used less fresh fruit than individuals without diabetes.

Richard Bryce reports about the health effects of a farmers’

market fruit and vegetable prescription program in type 2 diabetic patients with poor glycemic control. Interestingly, there was a significant decrease in hemoglobin HbA1c. The reduction in HbA1c (average 0.7 % units) is of clinical significance and is comparable to that reported to achieve with many diabetes drugs. Unfortunately, interest to participate remained quite low among those invited, and control group was missing. Nevertheless, the results suggest that cheap and innovative dietary approaches are needed to improve glycemic control in patients with type 2 diabetes.

F&V are rich in nutrients, vitamins and minerals, and they are important sources of dietary fiber and other non-nutritive compounds that may play a role in the prevention of chronic diseases. Besides F&V, whole grains and berries, used plenty e.g. in Nordic countries, have beneficial health effects. Replacing unhealthier food choices rich in saturated fats and processed meat products by fruit, vegetables and whole grain products has per se beneficial health effects. Furthermore, health impact may also originate from anti-oxidative and anti-inflammatory effects of F&V, and changes in gut microbiota may also play a role. Plenty of novel compounds are being recovered from human biological samples that are involved in health benefits of vegetable food.

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Mediterranean diet, DASH and AHEI to prevent type 2 diabetes

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The investigation of dietary patterns has emerged as a complementary approach to single food investigations by taking into account human nutrition as a combination of food items. Dietary pattern (DP) approaches can be divided in a priori approach using hypotheses about the benefit or detriment of specific food items on a certain health outcome or a posteriori approach applying exploratory methods on data at hand without previous knowledge. Furthermore, reduced rank regression (RRR), as a mixed approach, uses hypothesis-driven biomarkers or nutrients that are involved in the development of type 2 diabetes and identifies exploratory derived dietary patterns which explain the maximum variance in these biomarkers.

However, due to differences in methodological approaches and compositions of dietary patterns, conclusions on healthful patterns with regard to diabetes were rather limited. Attempts to summarize evidence from existing studies were either limited to healthful dietary patterns omitting information from dietary patterns that were not associated with type 2 diabetes or summarized risk estimates derived from different approaches without considering the constraint comparability.

Associations between dietary patterns and type 2 diabetes

Therefore, we summarized evidence of prospective studies which examined associations of dietary patterns with type 2 diabetes by considering different methodological pattern approaches. The search in MEDLINE and Web of Science identified prospective studies (cohorts or trials) associating dietary patterns with diabetes incidence in nondiabetic and apparently healthy participants and resulted in 48 articles from 16 cohorts.

The risk to develop type 2 diabetes for selected commonly applied diet quality indices was reduced:

- Mediterranean diet characterized by a high consumption of fruit, vegetables, legumes, nuts, fish and seafood and a moderate consumption of alcohol (RR* for comparing extreme quantiles: 0.87; 95% CI: 0.82, 0.93)
- Dietary Approaches to Stop Hypertension (DASH) based on plants and rich in fruit, vegetables and nuts with low-fat dairy and meats (RR*: 0.81; 95% CI: 0.72, 0.92)
- Alternative Healthy Eating Index (AHEI) including whole grains, vegetables, fruit (RR*: 0.79; 95% CI: 0.69, 0.90)

Besides, studies reported a variety of heterogeneous indices (n = 15) in terms of components and the way of constructing. For eight of these, a significant risk reduction (14% - 68%) was observed, but not meta-analyzed due to completely different approaches.

For exploratory dietary patterns, we identified 32 patterns derived in 14 studies. Because meta-analyses would not be meaningful for patterns of different composition, we evaluated similarities between individual component food groups and identified two

overall groups of patterns:

- "mainly unhealthy" group of patterns characterized by red and processed meat, refined grains, high-fat dairy, eggs, and fried products was associated with an increased diabetes risk by 44% (RR: 1.44; 95% CI: 1.27, 1.62)
- "mainly healthy" group of patterns characterized by vegetables, legumes, fruit, poultry, and fish was associated with a reduced diabetes risk by 16% (RR: 0.84; 95% CI: 0.77, 0.91)

Due to the population-specificity and heterogeneity of pattern structure, comparability between exploratory dietary patterns still remains limited and requires careful consideration in meta-analyses.

The search identified six RRR-patterns which were related significantly to diabetes risk, with the strongest association observed using thrombosis markers as responses. Meta-analyses of studies on RRR-patterns were only reasonable for originally derived RRR-patterns and their replications in other study populations. Across these identified RRR-patterns, irrespective of the biomarker sets and overall pattern composition, those characterized by high intakes of refined grains, sugar-sweetened soft drinks, and processed meat, were all significantly associated with increased diabetes risk.



Diets rich in F&V could prevent diabetes

Diets according to the Mediterranean Diet, DASH and AHEI have each a strong potential for the prevention of diabetes, irrespective of different particular components. The two identified groups of exploratory DP characterized by concordant food groups were significantly associated with diabetes risk, suggesting that the combination of several food groups allows the identification of diabetes-associated DPs, despite limited evidence for an association of single food groups. Still, exploratory DPs quite frequently remain population-specific observations. For three RRR-patterns consistent positive associations with diabetes were observed across independent populations, which might favor the RRR approach over purely exploratory approaches.

* Relative Risk

of diabetes and diabetes complications

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Although the health benefits of diets rich in fresh fruit and vegetables are well-established, worldwide evidence on the potential effects of fruit consumption on the development and progression of diabetes is rather limited. Fruit is a rich source of potassium, dietary fibre, antioxidants, and various other potentially active compounds, and contains little sodium or fat and relatively few calories. But, although higher fruit consumption has been rather consistently and convincingly related to lower risk of cardiovascular diseases, its sweetness, i.e. high sugar (fructose) content, has led to concerns about its potential harm for people with diabetes, particularly in China and many other East Asian countries, where the prevalence of diabetes is rising rapidly.

The research was conducted on 0.5 million Chinese adults from ten diverse urban and rural areas across China (*The China Kadoori Biobank*).

Fresh fruit consumers have a lower risk of diabetes

About 94% of participants were free of diabetes at baseline and the other 6% had either previously diagnosed diabetes or were defined as diabetes during baseline survey. In the study, the proportion of participants who reported never or rarely consuming fresh fruit was about 3 times higher in individuals with previously diagnosed diabetes than in those without diabetes. This indicates that the problem of fruit abstinence among diabetic patients was still quite common in China at 2004-2008 when the baseline survey was conducted. During 7-year follow-up, the study documented nearly 10,000 new onset cases of diabetes and, compared with non-consumers, daily fresh fruit consumers had a 12% lower risk of developing diabetes.

High fresh fruit consumption lowers overall mortality and diabetes-related complications

More importantly, about 11,000 cases of vascular diseases and

3400 deaths were recorded among those over 30,000 participants who had pre-existing diabetes already at the beginning of the study and higher fresh fruit consumption was also associated with lower risks of diabetes complications, with each 100g/day higher fresh fruit consumption was associated with 17% lower overall mortality, 13% lower risk of developing diabetes-related complications affecting large blood vessels (e.g. ischemic heart disease and stroke) and 28% lower risk of developing complications affecting small blood vessels (i.e. kidney diseases, eye diseases, and neuropathy).

"Fresh Fruit consumption should be recommended for all, including people with diabetes"!

Although the observational nature of the study does not allow a conclusion on causality, it provided strong supporting evidence for recommending a higher level of fruit consumption in people living with diabetes. However, the findings should not be interpreted as people (including diabetes patients) could eat as much fresh fruit as possible or even the more the better. People, particularly those with diabetes, should always keep an eye on the amount of total calories (carbohydrates) they consume and their body weight. In fact, in the current study population, the average fresh fruit consumption among those daily consumers (the highest category) was about 150 grams per day, roughly equivalents to a normal sized apple. Furthermore, the study focused on fresh fruit only and Chinese people usually eat whole fresh fruit raw as snack. Therefore, the potential benefit of fresh fruit on primary and secondary prevention of diabetes should not be extended to other fruit products such as fruit juice and fruit puree which may contain very high amount of added sugar (e.g. sucrose) and/or little fibre. Due to the limitation of data, the study could not answer questions such as what are the best types of fresh fruit, the best timing of fruit consumption (before or after a meal), and the main underlying mechanisms involved. Future studies on such research questions are warranted.



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Based on: Du H, Li L, Bennett D, Guo Y, Turnbull I, Yang L, et al. (2017) Fresh fruit consumption in relation to incident diabetes and diabetic vascular complications: A 7-y prospective study of 0.5 million Chinese adults. *PLoS Med* 14(4):e1002279. <https://doi.org/10.1371/journal.pmed.1002279>

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Fresh prescription: prescribing F&V as medicine

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Eating a diet rich in fruit and vegetables (F&V) may decrease the risk of developing type II diabetes and can be beneficial in the treatment of this condition once it develops. Despite these benefits, many people do not consume the recommended servings of F&V. This is especially true in lower socioeconomic areas. Many believe that this is due to lack of access to fresh produce for those who live in so-called food deserts. Unfortunately, even with improved F&V access, this does not always translate to increased consumption.

The patient population served at the Community Health and Social Services Center (CHASS) in Detroit, MI, certainly follows this trend. The majority of CHASS' patients are of lower socioeconomic status, are Latino or African American, and are Spanish speaking. Sadly, diabetes occurs at very high rates in our patients; many of whom struggle to eat the recommended amount of F&V.

The Fresh Prescription Program (Fresh Rx): an opportunity to prescribe F&V as a form of "medicine" to patients

At CHASS, we believe the physician has an opportunity help the patient see the connection between their food choices and their health. We aim to motivate our patients to become more actively engaged in health and wellness. We saw this as an opportunity to effect change in our patient population, so we brought the Fresh Prescription (Fresh Rx) Program to CHASS. This incredible program brings together the healthcare system and the food system, fostering innovative relationships to build a healthy sustainable food system in Detroit. The Fresh Rx program affords the opportunity for medical providers to prescribe F&V as a form of "medicine" to their patients. This prescription can be redeemed at the weekly farmers market located at the CHASS center.

To understand the efficacy of the program and in hopes of finding a more economically sustainable model, we elected to investigate the outcomes of Fresh Rx program. The purpose of this study was to examine the impact of participating in a community health center based farmers' market and fresh fruit and vegetable prescription program on changes hemoglobin A1C (HbA1C) concentration, blood pressure (BP) and weight in patients with uncontrolled type II diabetes at a Federally Qualified Health Center. The research followed 65 adults, uncontrolled, type II diabetes over the 13 weeks. The program allotted up to \$40 (\$10 for up to four weeks) for purchase of produce from the clinic based local farmer's market. HbA1C, BP and weight were collected within three months of program's start and within three months of completion.

F&V prescription program decreased hemoglobin A1C concentration in type 2 diabetic patients

A statistically significant ($p=0.001$) decrease in HbA1C was found (9.54% to 8.83%). However, weight (208.3 to 209.0) and BP (135.1/79.3 to 135.8/77.6) did not change from pre-to post-study ($p > .05$).

The findings suggest the importance of a F&V prescription program in low-income patients with type II diabetes in regards to improved health outcomes, specifically a statistically significant decrease in HbA1C. We believe the success of the program comes from the connection made between health and nutrition. This education is provided by those involved in the program: the prescribing provider, the community health worker, and those doing cooking demonstrations at the farmer's market. The market is co-located with the clinic, further bolstering that connection between good food and good health. As Hippocrates stated "let food be thy medicine and medicine be thy food."

Healthcare providers have a unique opportunity to offer this type of "prescription" and to empower their patients to make positive and lasting change in their lives. We are tasked with improving the health and wellbeing of our patients and should embrace opportunities to think outside of the prescription bottle.



Based on: R. Bryce, C. Guajardo, D. Ilarrazza, N. Milgrom, D. Pike, K. Savoie, F. Valbuena and LR. Miller-Matero. Participation in a farmers' market fruit and vegetable prescription program at a federally qualified health center improves hemoglobin A1C in low income uncontrolled diabetics. Preventive Medicine Reports 7 (2017) 176-179.