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Mini Review

Fruits, Vegetables, and Food Guides: Design Challenges

Norman J Temple*, Christopher Workman

Centre for Science, Athabasca University, Alberta, Canada

Abstract

Food guides used in different countries all emphasize a generous intake of fruits and vegetables. However, there are major differences in how these foods are classified. Some food guides place fruits and vegetables into two food groups while others combine them into one food group. Some food guides state that the intake of juices should be limited. Potatoes are included with vegetables in some food guides but with grains and cereals in others. This paper critically evaluates these issues. It is proposed that food guides should: (1) place fruits and vegetables into a single food group but with advice to eat a variety of different types of these foods; and (2) include juices and potatoes as part of the fruit and vegetables group but state that intake of juices (especially fruit juices) and of potatoes (especially French fries) should be limited.

Keywords: Fruits; Food guides; Fruit juices; Potatoes; Vegetables

Introduction

Dozens of countries have developed food guides. These aim to translate complicated nutritional recommendations into easy-to-understand guidelines for food consumption. It is firmly established that fruits and vegetables are critically important components of a healthy diet. For that reason a generous intake of these foods is a central feature of all food guides [1,2]. However, there are notable discrepancies between food guides in the area of fruits and vegetables, a subject that is briefly examined in this paper.

Fruits and Vegetables: One or two food groups?

Roughly half of food guides separate fruits and vegetables into two food groups (e.g., the USA, Germany, and Japan) while the other half combine them into one food group (for example, the UK , Canada, and China) [3-10]. The pros and cons of these two different designs have received little attention. The case for keeping fruits and vegetables together in one food group centers on the following self-evident advantages of this design: first, it makes food guides as clear and simple as possible; and, second, it gives people maximum flexibility in their food choices. But a strong case can be made for placing fruits and vegetables into separate food groups if one or both of the following is shown to be true:

1. There are major differences in the nutritional value of fruits and vegetables; if people fail to eat a sufficient amount of both types of food, they will receive inadequate amounts of particular nutrients and phytochemicals.
2. Epidemiological evidence demonstrates that risk of major diseases, or of total mortality, is maximally reduced when people consume adequate amounts of both fruits and vegetables; eating the same quantity of fruit only or of vegetables only provides significantly less benefit.

We now consider these issues. Fruits and vegetables are major sources of dietary fiber and of various micronutrients including vitamin C and folate. There are wide variations in the concentration of these substances between different fruits and vegetables [11]. Overall, however, fruits and vegetables are comparable in their content of fiber and most micronutrients. But vegetables are a significantly richer source of vitamin K, magnesium, and potassium. Leafy green vegetables are an especially rich source of several micronutrients.

Phytochemicals are a diverse class of bioactive substances found in a wide variety of plants [12,13]. A modest amount of evidence has accrued suggesting that some phytochemicals may be protective against various diseases including cardiovascular disease, cancer, diabetes, and eye diseases [14-18].There are major differences between different types of fruits and vegetables in their content of phytochemicals. Prudence suggests, therefore, that the diet should include a wide variety of fruits and vegetables so that it supplies a broad range of phytochemicals.

This overview of the evidence suggests as follows. Based on their content of micronutrients, vegetables, especially leafy green vegetables, should be an integral part of the diet. Based on their content of phytochemicals, people should eat a wide variety of fruits and vegetables. But what is not known is the extent to which these nutritional differences between different types of fruits and vegetables affect health and risk of disease. Future research needs to expand our understanding of these issues.

Epidemiological studies have provided much valuable evidence regarding the association between fruits and vegetables and risk of several diseases. Aune et al. recently published a systematic review and meta-analysis of many prospective cohort studies [19].

***Corresponding author:** Norman J Temple, Centre for Science, Athabasca University, Athabasca, Alberta T9S 3A3, Canada, Tel: +780 4500167 ; Email: normant@athabascau.ca

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The findings presented in that paper are used here as they reveal the strength of the associations for fruits and vegetables, both separately and combined. There is strong evidence that fruits and vegetables are protective against cardiovascular disease (CVD, including both coronary heart disease and stroke), cancer, and all-cause mortality. However, there is no clear pattern suggesting that fruits have a stronger protective association than do vegetables (or the reverse). Of particular relevance for the present discussion, the analysis found no indication that the protective association is stronger for fruits and vegetables combined rather than these foods separately. These findings suggest that the health benefits of fruits and vegetables can be obtained from fruits alone or from vegetables alone.

Wang et al. carried out a similar systematic review and meta-analysis but with a focus on type 2 diabetes [20]. As with the above analysis fruits and vegetables were found to be protective. Once again, there was no indication that the association is stronger for fruits and vegetables combined rather than fruits and vegetables separately.

The above researchers also calculated the association between individual types of fruits and vegetables and the different outcomes. The strongest protective associations were seen for green leafy vegetables, green yellow vegetables, and cruciferous vegetables.

These findings from prospective cohort studies provide convincing evidence that fruits and vegetables are protective against several major diseases while also reducing all-cause mortality. However, we see little evidence for a synergistic action between fruits and vegetables: it appears that the benefit can be obtained by eating either fruits alone or vegetables alone. This conclusion should be seen as tentative: much additional research is needed in order to solidify these findings and extend them to other areas of health.

We can now summarize the findings from the two broad types of investigation. as follows:

1. Fruits and vegetables have a broadly similar content of micronutrients. However, vegetables, especially leafy green vegetables, are superior with respect to a handful of micronutrients. A consideration of phytochemicals suggests that people should eat a wide variety of both fruits and vegetables.
2. Findings from prospective cohort studies indicate that the benefit of a generous intake of fruits and vegetables can be obtained by eating either fruits alone or vegetables alone.

There is some inconsistency between those two sets of observations: while inferences from the food content of bioactive substances is suggestive that people should, ideally, eat both fruits and vegetables, findings from cohort studies indicate people can obtain the health benefit of fruits and vegetables by eating either fruits alone or vegetables alone.

Greater weight should be given to findings from cohort studies as these indicate the direct impact of food on disease risk. Accordingly, it makes most sense that food guides combine fruits and vegetables into one food group while stressing that people should eat a wide variety of these foods. This achieves the best of each world: the food guide recommends a diet that will help prevent major diseases while also keeping the food guide as simple as possible. Again, the caveat is added that much more research is needed into these issues.

Many food guides do indeed incorporate these design features. Countries that combine fruit and vegetables into one food group often include a statement encouraging people to eat a variety of both fruits and vegetables. The UK food guide comes nearest to the suggestions made above. It advices people as follows: "Aim to eat at least five portions of a variety of fruit and veg each day". However, other food guides are more prescriptive and make a specific recommendation for the amounts of both fruits and vegetables. For example, the Swiss food guide states:"5 portions per day of different colours, at least 3 por¬tions should be vegetables and 2 fruit" [21]. Similarly, the food guide used in the Netherlands says: "Eat at least 200 grams of vegetables and at least 200 grams of fruit daily" [22].

Food guides and fruit Juices

A notable discrepancy between the food guides is in the advice given for the intake of fruit juices. Some food guides include fruit juices with other fruits (for example, the USA and Austria), but other food guides recommend strict limits on the intake of juices (e.g., the UK and Switzerland) [23,24].

The evidence regarding the positives and negatives of fruit juices is confusing. Drinking fruit juice can enhance the nutritional quality as it is a convenient way to boost the intake of fruit while also displacing sugar-sweetened soft drinks. This may be especially important with children and adolescents. But juices have little of the fiber found in whole foods. Their concentration of simple sugars is similar to that of sugar-sweetened soft drinks. Their ease of consumption (low satiety) means they can contribute to excessive energy intake. A few prospective cohort studies have examined the association between fruit juices and CHD, stroke, and all-cause mortality but findings have been inconsistent [25]. Other evidence suggests that a moderate intake of fruit juices does not pose a health risk apart from an increased risk of tooth decay in children. Fruit juice appears to have essentially no effect on weight gain in children and adolescents, though it may lead to a small degree of weight gain in adults [26-28]. There is also evidence of a slight increase in risk of type 2 diabetes with high intake of fruit juices [29].

How should this contradictory information be translated into the advice that goes into food guides? Important goals are to encourage increased intake of fruit and reduced intake of sugar-sweetened soft drinks (especially by young people). It is suggested here that food guides should state that fruit juices may be included in the diet as part of the fruit and vegetables group but that intake of juices should not exceed one or two servings per day. Clearly, more research is needed into these issues.

Food guides and potatoes

Potatoes are another food that pose a dilemma. They are among the most affordable type of vegetable. Many food guides include potatoes with vegetables; this is the case in, for example, the USA, Japan , and Australia [30]. But the food guides used in other countries, such as the UK, Germany, Austria, and the Netherlands, include potatoes with grains and cereals.

Without doubt placing potatoes in the same food group as grains and cereals causes confusion for many consumers. Is this justified? The one major nutritional similarity that potatoes have with grains and cereals is their high content of starch. But in most respects they

are similar to other vegetables. They are a valuable source of dietary fiber, potassium, vitamins B6 and C, and several other micronutrients. They are also a major contributor of phytochemicals, supplying a quarter of the phenolics in the American diet.

There is mixed evidence regarding the relationship between consumption of potatoes and health. Findings from prospective cohort studies suggest that potatoes have a weak association with weight gain but no association with risk of CHD, stroke, colorectal cancer, or all-cause mortality [31]. Overall, boiled and baked potatoes have fairly little effect on health in contrast to the clearly beneficial effects of most other vegetables. But potatoes may pose some health risk when eaten as French fries as they appear to increase the risk of type 2 diabetes and hypertension [32].

Based on these considerations food guides should place potatoes in the fruit and vegetables group but with the caveat that intake should not exceed one serving per day and that they should be eaten as boiled or baked potatoes rather than as fries. It must be stressed that the supporting evidence for this conclusion is far from solid and that much more research is needed.

Summary

The evidence reviewed here leads to the conclusion that food guides should combine fruits and vegetables into a single food group but with added advice that consumers should eat a variety of different types of these foods. This design of food guides achieves the best of each world: a single food group is easier for the general population to remember and to follow, while the added advice encourages people to optimize their diet.

Juices should be included with the fruit and vegetables group. Advice should be added stating that intake of juices, especially fruit juices, should be limited to no more than one or two servings per day. Potatoes should also be included with the fruit and vegetables group. Similarly to fruit juice intake of potatoes should be limited, especially of French fries.

The proposals made here reflect the best evidence currently available. However, there are clearly many uncertainties in the evidence. For that reason there is a need for additional research.

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