



# Journal of Nutrition and Food Security

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School of Public Health  
Department of Nutrition  
Nutrition & Food Security Research Center



eISSN: 2476-7425

pISSN: 2476-7417

JNFS 2022; 7(2): 256-264

Website: jnfs.ssu.ac.ir

## Review of Nutrition Policy Options for Increasing Fruit and Vegetable Consumption in the Populations: Lesson Learned and Policy Implications

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### ARTICLE INFO

#### REVIEW ARTICLE

#### Article history:

Received: 10 Apr 2021

Revised: 6 Jul 2021

Accepted: 16 Aug 2021

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### ABSTRACT

**Background:** The development of policies for increasing fruit and vegetable consumption is highlighted as a priority in developing countries. This review study aimed to present the available policy options for increasing fruit and vegetable consumption in the populations. **Methods:** To collect relevant English publications, five electronic databases, including PubMed/Medline, Scopus, Embase, ProQuest, and Ovid from 2000 until 1<sup>st</sup> January 2021 were searched. The national or population based programs aimed to increase fruit and/or vegetable intake were included. Four types of policy options were recognized, including food promotion, school and workplace food environment regulations, agriculture, food production, supply and storage, and fiscal policies. **Results:** Increasing consumer's knowledge has been more effective in increasing fruit and vegetable consumption among populations. However, most of the interventions in the workplace and school emphasize increasing knowledge and changing access to healthy food. **Conclusion:** In general, the evaluation of these policies has been done in the short term and has had a moderate impact on changing dietary behavior. Agricultural and food supply chain policies are currently less researched. Finally, recent evidence suggests that multi-component interventions are more effective than one-component interventions.

**Keywords:** Non-communicable diseases; Fruit; Vegetable; Nutrition policy

### Introduction

Non-communicable diseases (NCDs) are the leading cause of mortality and annually more than 41 million deaths (71%) are attributed to this health problem worldwide. (Azizi *et al.*, 2009). Promoting healthy diets in all age groups, particularly among children and adolescents can be

an effective strategy to prevent chronic diseases (Rodriguez *et al.*, 2019).

Based on evidence, the risk for all-cause and cardiovascular diseases (CVD) mortality is lower in those who consume higher amounts of fruit and/or vegetable compared to those consume less (Aune *et*

*This paper should be cited as:* Pourmoradian S, Kalantari N, Ostadrahimi A, Eini-Zinab H, Milani-Bonab A. *Review of Nutrition Policy Options for Increasing Fruit and Vegetable Consumption in the Populations: Lesson Learned and Policy Implications. Journal of Nutrition and Food Security (JNFS), 2022; 7 (2): 256-264.*

al., 2017, Yip *et al.*, 2019). Moreover, high consumption of fruit and/or vegetable can reduce the risk of obesity (Schwingshackl *et al.*, 2015), hypertension (Wu *et al.*, 2016), and diabetes (Li *et al.*, 2014). Antioxidant components of these two food groups, including vitamins, polyphenols, and flavonoids can play a key role in health promotion (Yahia, 2010).

Adequate consumption of fruits and vegetables can reduce the consumption of high-fat foods. Most populations have not yet reached the recommended intake of enough fruits and vegetables, i.e. 400 to 500 grams per day (Appleton *et al.*, 2016). Hence, nutritionists attempt to provide strategies to improve the consumption of fruits and vegetables considering various dimensions of community in target populations. To the best of the authors' knowledge, no policy review has provided a summary on community-based interventions in adult populations and younger ones to increase fruit and vegetable consumption.

### Overview of Methodology

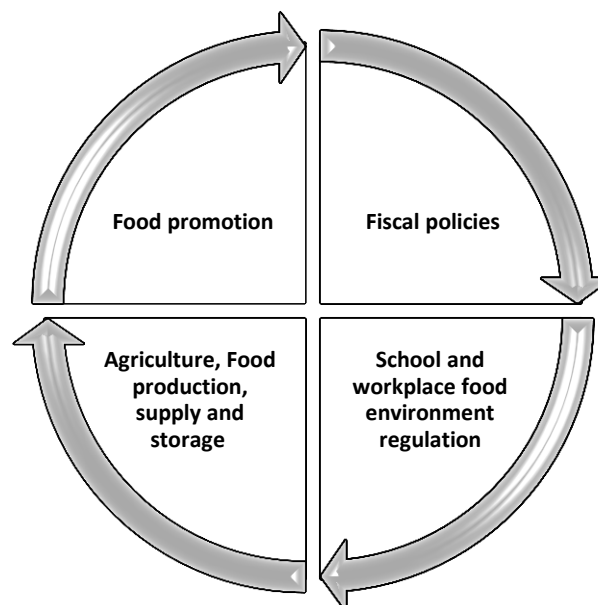
For the purposes of this review, PubMed/Medline, Scopus, Embase, ProQuest, and Ovid were searched from 2000/01/01 until

2020/01/01 with language limitation. Only publications with English language were included.

Search terms included combination of "fruit", "vegetable" and "intervention", with "policy" and "effectiveness". Grey literature (e.g. conference papers, theses, interviews, protocols, comments, and short communications) was obtained through Google searches and Elsevier (first 20 pages of results). Apart from electronic search, the reference lists of the eligible papers and relevant review papers were hand-searched to avoid missing relevant studies.

Studies which examined community-based intervention with sample size larger than 1000, examining fruit/vegetables intake before and after the interventions were included. In the present study, primary outcome was fruit and/or vegetable intake. Therefore, if a study examined whole diets or specific dietary patterns without pointing to the effects of an intervention on fruit/vegetable intake, separately, it was excluded as well.

After screening all publications found by electronic databases, four groups of policy options were identified using the 4Ps framework (price, place, promotion, and product) (Donovan, 2011) (**Figure 1**).



**Figure 1.** Food policies for increasing fruit and vegetable consumption in population level

## Theoretical framework

The health policies are divided into upstream and downstream interventions. The 'downstream' policies aim to promote healthy eating through behavioral interventions at individual levels, while the 'upstream' policies focus on providing healthier environments. The upstream policies could be categorized according to the 4Ps (price, place, promotion, and product) social marketing framework. In this framework, food price refers to policies affecting prices through taxes, subsidies, or economic incentives. Food promotion refers to policies, such as advertising/marketing particularly for children, media campaigns, and health education. Food provision is about policies implemented in specific settings, such as schools or workplaces. Food composition refers to the reformulation or elimination of some nutrients from food, food labeling of food products, and menu labeling of served food in stores/restaurants. Food supply chain, trade, and investment include legislation or regulation affecting production policies or supply-chain logistics (Zinab *et al.*, 2019).

## Results

The included clinical trials were published between 2000 and 2015.

### Policy options identified in literature

*1. Food promotion:* Increasing consumer's knowledge through mass media and social marketing is part of a government program to promote healthy eating. This type of intervention can increase the consumption of fruits and vegetables by 0.4 to 1.4 servings per day (Brambila-Macias *et al.*, 2011, Thomson and Ravia, 2011). Increasing public nutrition information is a feasible and cost-effective tool to increase the consumption of fruits and vegetables. In this case, various social campaigns have been conducted around the world, the main slogan of which has been to increase the consumption of fruits and vegetables to five servings per day (Dixon *et al.*, 1998, Foerster *et al.*, 1995, Herbert *et al.*, 2010).

Several studies have examined the effectiveness

of fruit and vegetables campaign in the United States, United Kingdom, Denmark, New Zealand, and Australia. The "Go for 2 & 5" campaign in the Australia increased fruit and vegetable consumption by 0.8 serving/day after 3 years (Pollard *et al.*, 2008). However, "5 A Day for Better Health" in the United had no significant effect on adult fruit and vegetable consumption, but in children led to increased consumption of fruits and vegetables about 5-7%, respectively. The "6 a day" campaign was another distinguished public awareness campaign which was conducted in Denmark between 1995 and 2004. The assessment of this campaign indicated the success of this program in increasing fruit and vegetable consumption in Danish population (Rekhy and McConchie, 2014). A similar campaign in the UK was able to increase average fruit and vegetable consumption by 60-200% and reduce unhealthy food consumption by 20 to 100% (Pérez-Cueto *et al.*, 2012). "5+A Day" program in New Zealand also led to 23% increase in fruit and vegetable consumption between 1995 and 2012. In 2011, 60.4% of New Zealand's population consumed 2 servings of fruit and 66% of the population consumed 3 servings of vegetables (Rekhy and McConchie, 2014).

Holding these campaigns have several limitations, e.g. the annual cost of such campaigns was estimated at about \$ 2.27 per person, approximately two-thirds of them was used in the distribution of educational materials, such as pamphlet and newsletter to increase fruit and vegetable consumption and the rest was used for employ staffs for designing, implementing and monitoring interventions. However, social marketing takes time to really bring desirable changes in attitudes and behaviors among populations (Sassi *et al.*, 2009). Holding social marketing for a long period and continuously requires funding from governments. Short-term campaign are doomed to failure due to people's environmental exposure to various factors that encourage them to unhealthy behaviors (Sassi *et al.*, 2009, Wymer, 2010).

2. *School and workplace food environment regulations:* This type of program include curriculum education on the health benefits of fruit and vegetable consumption or environmental advertising in the school through posters, pamphlet distribution any canteen distribution regulations, rules for vending machines in schools and the workplace, free distribution of fruits and vegetables to students and staff, or a combination of these interventions (Delgado-Noguera *et al.*, 2011, French and Stables, 2003, Knai *et al.*, 2006).

Three studies have examined the effect of free distribution or subsidies on fruits and vegetables for 1 to 2 years in the school environment in Norway and the United Kingdom (Bere *et al.*, 2005, Moore and Tapper, 2008, Ransley *et al.*, 2007). Various meta-analysis studies have shown that this type of policy could increase fruit and vegetable consumption by 0.02 to 0.44 servings per day, which is not statistically significant (Jaime and Lock, 2009, Twiss *et al.*, 2009). These results probably indicate the fact that the interventions intended to change nutrition behavior are more effective and the desired results cannot be achieved only with free distribution or price reduction. In recent studies, the health policy experts and stakeholders prioritized this policy option as less effective in increasing fruit and vegetable intakes in Iranian population (Zinab *et al.*, 2019) Today, with the recent improvement in the technology, computers and smart mobile phones are used in educational interventions in the school environment. Studies have shown that compared to other policy options, such as free distribution of fruits and vegetables or interventions, educational interventions are one of the most cost-effective interventions in the school environment (Delgado-Noguera *et al.*, 2011, Francis *et al.*, 2010).

Another strategy in schools is implementing school gardening program. In the study conducted by Triador in Canada, 7 months school gardening program increased children's preferences for vegetables and fruit in the school but self-reported home consumption did not change. These program empower students' gardening knowledge and skills, such as growing, preparing, and tasting new

fruit and vegetables. These result showed the importance of family participation to promote home consumption of fruit and vegetables (Triador *et al.*, 2015). Parmer *et al.* elucidated that implementing school-based gardening with nutrition education can increase fruit and vegetable knowledge and cause behavior change among children (Parmer *et al.*, 2009). This type of intervention was a cost-effective policy, mostly implemented in developed countries i.e. USA and Canada. Studies were required to investigate its effects in developing countries.

School salad bars are another important program offered as part of the school meals program by governments. In the USA, government endorsed schools using salad bars and upgrading cafeteria equipment to support providing healthier foods to children (French and Wechsler, 2004). Several studies indicated that school salad bars increase the amount and variety of fruits and vegetables consumed by children in schools. Moreover, Harris *et al.* suggested that coalition-building across government, non-governmental organization (NGO), and industry partners are required to afford salad bar expenses and equipment in the schools (Harris *et al.*, 2012).

Work-place initiatives focus on the built environments and support information, with the aim of increasing the availability of fresh fruit and vegetables and providing information about healthy food choice through point-of-choice labeling and dissemination of educational materials (Sorensen *et al.*, 2004). An example of successful workplace intervention is the "6 a day" campaign in Denmark, which signed an agreement with companies to distribute free fruit and vegetables to their employees. This intervention resulted in daily consumption of 3.42 servings of fruit and vegetables (Pérez-Cueto *et al.*, 2012).

The Treatwell 5-a-Day study was another successful worksite program, which was added a family component. The program demonstrated that fruit and vegetable consumption were the greatest in the worksite-plus-family condition (0.5 serving/day greater than the control condition) (Sorensen *et al.*, 1999).

The "Fruit and Vegetable Environment, Policy, and Pricing" Workshop was held by the USA National Center for Chronic Disease Prevention and Health Promotion in 2004. Conclusions from the workshop revealed that future research is needed to identify key policy and program components that will yield meaningful increases in fruit and vegetable consumption; barriers/facilitators of organizational and environmental change within worksites; effective community-based participatory methods; and methods to disseminate cost-effective interventions for all worksites (Sorensen *et al.*, 1999).

*3. Agriculture, food production, supply, and storage:* Due to the seasonal nature of fruits and vegetables, access to fresh fruit and vegetables may be limited in the cold months of the year. Agricultural policies can provide access to fruits and vegetables by providing infrastructure, such as cold storage, promoting greenhouse cultivation, which it can even prevent the price fluctuation. On the other hand, in developing and even developed countries, such as the United States, home gardens is another proposed policy (Brambila-Macias *et al.*, 2011). Supporting home gardens by teaching the principles of cultivation and harvesting, as well as allocating the resources by governments, in addition to increasing the availability and consumption of fruits and vegetables, can even lead to income generation by selling surplus of products by families. Nepal and Bangladesh are among the countries that have been successful achievements in this policy (Hyseni *et al.*, 2017). In the cross-sectional study conducted by Alaimo K (Alaimo *et al.*, 2008), adults with a household member who participated in a community garden consumed fruits and vegetables 1.4 more times per day than those who did not participate, and they were 3.5 times more likely to consume fruits and vegetables at least 5 times daily.

*4. Fiscal policies:* The fiscal interventions including, reducing fruit and vegetable prices in supermarkets along with healthy food selection training; providing subsidies for fruits and vegetables and support packages or food coupons

containing free fruits and vegetables for the people with low socioeconomic status have been implemented or are being implemented in different communities. Food stamps or free distribution of fruits and vegetables to increase access for vulnerable groups have been considered as a form of financial intervention by various communities.

The UK has a food stamp program called Healthy Start, in which eligible families can receive free coupons every week to buy fresh milk, fruits, and vegetables. This program could increase fruits and vegetables and plain cow's milk consumption in low income pregnant women, and unintentionally reduce food expenditure of the participants (Ohly *et al.*, 2017). In the United States, various programs, such as the WIC (Women, Infants, and Children), and the SNAP (Supplemental Nutrition Assistance Program) are provided for children and poor families to ensure they have enough access to a healthy diet. The SNAP program primarily serves to direct farm surplus food to the poor and disabled, as well as a welfare program for poor families who are unable to eat properly. Few studies have examined the effect of food stamps or the distribution of free fruits and vegetables (Black *et al.*, 2012). In a clinical trial in obese women, giving \$ 10 per week for 6 months to buy fruit and vegetables increased fruit consumption by one serving per day and vegetable consumption by 0.9 serving per day (Kennedy *et al.*, 2009). In another similar study of WIC participants in California, providing a \$ 10 weekly subsidy to buy fruit and vegetables from supermarkets or local markets increased fruit and vegetable consumption in the intervention group by 3.9 to 4.1 serving per day, while in the control group consumption was remained 3 servings per day. The follow up study reported that this increase in the fruit and vegetable consumption remained constant until 6 months after the intervention (Herman *et al.*, 2006). The results of cohort studies showed that 10-25% decrease in fruit and vegetable prices was associated with 0.38 and 0.65 servings per day and increased fruit and vegetable consumption. They also concluded that the price elasticity of demand for fruits and vegetables is so

high; therefore, with a 1% reduction in the price of these products, consumption increases by more than 1% (An, 2013). Most of studies which investigated the effect of financial interventions on fruit and vegetable consumption are of the modeling type. In a modeling study, a 20% subsidy on fruits and vegetables increased consumption by 10% (Powell *et al.*, 2013), but Mozaffarian *et al.* estimated that a 10% subsidy on fruits and vegetables would increase consumption by 2-5%. A combination of a tax on unhealthy foods and the use of this revenue (\$580 million) to subsidize fruits and vegetables could prevent 6,000 deaths from cardiovascular disease and cancer (Mozaffarian *et al.*, 2012). In another modeling study, it was estimated that a subsidy that leads to a stable price reduction of 1% could prevent 6733 cases of heart disease and 2946 cases of ischemic stroke (Thow *et al.*, 2014), which is in line with the results of another study in the same field (Capacci *et al.*, 2012).

### Conclusion

This review provided the scientific rationale to increase fruit and vegetable consumption, which provides insights for health policy makers. As mentioned earlier, the policy of increasing consumer's knowledge has been more effective in increasing fruit and vegetable consumption. These policies require longer time and the use of technology in the implementation and financing of governments to be more effective. Interventions in the workplace and school emphasize increasing knowledge and changing access to food. These types of interventions should be developed with recommended guidelines, workplace characteristics, long-term follow-up and objective outcomes for diet, health, and cost. In general, the evaluation of these policies in this field has been done in the short term and has had a moderate impact on the change of dietary behavior. Agricultural and food supply chain policies are currently less studied, and finally, multiple interventions are more effective than one-component interventions, as evidenced by comprehensive national programs in different

countries. However, fiscal policies seem to be consistently effective in increasing the consumption of fruit and vegetables in low income populations.

### Acknowledgment

We kindly acknowledge the National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, for their financial support. This article was extracted from Pourmoradian's Ph.D dissertation.

### Conflict of interests

The authors declare that they have no competing interests.

### Authors' contributions

Kalantari N and Eini-Zinab H contributed to the conception of the study, and Pourmoradian S and Milani Bonab A assisted with the search strategy and data extraction. Pourmoradian S and Ostadrahimi A were responsible for drafting the manuscript. All authors drafted the study, revised it critically for important intellectual content, and approved the final version to be published.

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