The European Common Agricultural Policy on fruits and vegetables: exploring potential health gain from reform

J. Lennert Veerman¹, Jan J. Barendregt¹,², Johan P. Mackenbach¹

Background: Consumption of fruits and vegetables is associated with a reduced risk of cardiovascular disease and cancer. The European Union Common Agricultural Policy keeps prices high by limiting the availability of fruits and vegetables. This policy is at odds with public health interests. We assess the potential health gain for the Dutch population of discontinuing EU withdrawal support for fruits and vegetables. Methods: The maximum effect of the reform was estimated by assuming that a quantity equivalent to the amount of produce withdrawn in recent years would be brought onto the market. For the calculation of the effect of consumption change on health we constructed a multi-state life table model in which consumption of fruits and vegetables is linked to ischaemic heart disease, stroke, and cancer of the oesophagus, stomach, colorectum, lung and breast. Uncertainty is quantified using Monte Carlo simulation. Results: The reform would maximally increase the average consumption of fruits and vegetables by 1.80% (95% uncertainty interval 1.12–2.73), with an ensuing increase in life expectancy of 3.8 (2.2–5.9) days for men and 2.6 (1.5–4.2) days for women. The reform is also likely to decrease socioeconomic inequalities in health. Conclusion: Ending EU withdrawal support for fruits and vegetables could result in a modest health gain for the Dutch population, though uncertainty in the estimates is high. A more comprehensive examination of the health effects of the EU agricultural policy could help to ensure health is duly considered in decision-making.

Keywords: fruits, health impact assessment, modelling, quantitative method, vegetables

Consumption of fruits and vegetables is associated with a reduced risk of cardiovascular disease and several types of cancer.¹,² The World Health Organization recommends a daily intake of at least 400 g per person.³ However, many EU citizens do not reach this level of consumption, especially in northern and central European countries.⁴ According to the 2002 World Health Report this low intake accounts for 4.3% of the burden of disease in men and 3.4% in women in the EU.³ Fruit and vegetable consumption is disproportionately low in groups with low income and education levels and thus contributes to socioeconomic inequalities in health.⁵,⁶ In the Netherlands the trend over time is towards lower consumption levels with young people consuming less than older generations.⁸

The European Union’s Common Agricultural Policy (CAP) was introduced after the Second World War to ensure food security in Europe. For fruits and vegetables it uses two mechanisms. First, it imposes import tariffs. Second, it supports producers by guaranteeing a minimum price for their produce. When the price drops below a specified intervention level, the EU finances the withdrawal of fruits and vegetables from the market (‘withdrawal support’). Most of this surplus is destroyed. In other words, the EU policy keeps prices high by limiting availability. This has been termed a threat to public health which should be terminated.⁹ Reforms in 1996 roughly halved the amount of fruits and vegetables withdrawn, but recent years have shown no further downward trend.

In this paper, we attempt to quantify the health gain for the Dutch population that would result from ending EU withdrawal support for fruits and vegetables. We use a simple policy model that allows estimation only of a maximum effect. The true effect is likely to lie between this maximum and zero effect.

Methods

The research question can be divided into two sub-questions. First, what is the effect of the suggested policy change on the consumption of fruits and vegetables? And second, what does this consumption change mean for the health of the population? Accordingly, the methods are subdivided into those that examine the effect of the policy on exposure to determinants of health and those that translate this altered exposure into health outcomes.

From policy to determinant

Over the period 1997–2001 the total annual availability of fruits and vegetables in the EU was estimated at 70 million tonnes, and on average 1.27 million tonnes per year was withdrawn. Over these years the amount withdrawn fluctuated without a clear trend. The maximum effect that ending withdrawal could have is equal to the amount withdrawn, which we based on these historical data. In this scenario, all produce is brought onto the market and prices would drop until demand equals supply and the market clears. Not all that is sold is consumed; we assumed that the percentage lost remains unchanged.

From determinant to health outcomes

To answer the second question and estimate the effect of changes in fruit and vegetable consumption on population health we created a mathematical model. This proportional multi-state life table model compares two populations: one that is modelled after the Dutch population and an identical population for which the fruit and vegetable intake can be manipulated.¹⁰ Consumption data from the most recent national nutrition survey were fitted to a Weibull distribution. Assuming that the shape-parameter of the distribution over the population

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were interpreted as such a: For ischaemic heart disease and cerebrovascular accident no confidence intervals were available but the values stated

Breast cancer 0.98 (0.96–0.99) per 100 g per day increase

Lung cancer 0.87 (0.80–0.93) per 100 g per day increase

Stomach cancer 0.78 (0.72–0.84) per 100 g per day increase

Colorectal cancer 0.93 (0.88–0.98) per 100 g per day increase

Oesophageal cancer 0.81 (0.72–0.90) a

Cerebrovascular accident 0.8 (0.60–0.95) a

Table 1 Relative risks of disease incidence according to fruits and vegetable consumption

<table>
<thead>
<tr>
<th>Disease</th>
<th>Relative risk (95% confidence interval)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic heart disease</td>
<td>0.8 (0.65–0.90) a</td>
<td>&gt;400 versus 0–99 g per day</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>0.8 (0.60–0.95) a</td>
<td>&gt;400 versus 0–99 g per day</td>
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<td>Oesophageal cancer</td>
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remains stable, the model allows manipulation of the distribution by changing the mean consumption level. Consumption levels influence the incidence of ischaemic heart disease, stroke, and cancer of the oesophagus, stomach, colorectum, lung and female breast. This effect is quantified via the potential impact fraction (PIF): the proportional change in expected incidence as a consequence of a specified change in exposure level.11 PIF is calculated on the basis of age- and gender-specific exposure data and the relative risks of disease incidence at the corresponding levels of exposure. The relative risks used are shown in table 1.

A change in incidence causes changes in prevalence and mortality. Finally, the different disease-specific data are integrated in a life table from which summary measures of population health such as life expectancy, years lost to disease and disability-adjusted life years (DALYs) can be derived. The difference in health outcomes of the two populations is attributed to the intervention, i.e. the change in consumption of fruits and vegetables. Inputs for the model were the most recent estimates of disease frequency provided in the National Public Health Compass,12 population data and mortality rates from the Central Bureau of Statistics, consumption data from the National Nutrition Survey 1997–1998, estimates of relative risk of coronary heart disease and stroke from a review by Jansen et al.1 and of cancer from a recent meta-analysis,13 and the Dutch disability weights.14 The model was implemented in Excel.

Uncertainty in the estimates was obtained by Monte Carlo simulation using the computer programme @risk version 4 (Palisade, London), including the uncertainty in the relative risk estimates and in the amount of extra fruits and vegetables consumed.

Results

If EU price support for fruits and vegetables were abolished and all previously withdrawn produce were sold, this would mean an average increase in consumption of 1.80% (95% uncertainty interval 1.12–2.73), or ~3–6 g per person per day on average. The resulting shift in the consumption pattern is illustrated in figure 1.

This change in consumption of fruits and vegetables would result in declines in the incidence of cardiovascular disease and cancer and improved population health, as shown in table 2.

Discussion

Ending EU subsidies for the withdrawal of fruits and vegetables and allowing the produce onto the market would result in modest health gains for the Dutch population: an estimated annual gain of 1930 DALYs, or an increase in life expectancy by 3.8 days for men and 2.6 days for women, at maximum.

This health gain may look disappointing for an intervention that affects such a large population. The reason for the modest effect lies mainly in the small shift in consumption patterns that would result from the suggested reform of EU policy. The protective effect of fruits and vegetables is also quite moderate (see table 1), but nevertheless the total burden of disease due to inadequate intake of fruits and vegetables is considerable: if the whole population were to consume at least 400 g per day, life expectancy for men would rise by more than half a year, and women would gain about 4 months. The reform would fill the gap between the ideal and reality to only a small degree. To put the health gain into perspective: breast cancer screening is estimated to increase life expectancy by about 35 days compared with 2.6 for the intervention evaluated here, but it is also more resource demanding.15

Modest as they may be, these estimates represent a maximum health gain. The underlying assumption is that all produce now taken off the market would be sold as a result of the reform, which can only be an overestimation. In reality, lower prices are likely to discourage production of fruits and vegetables, which would lead to rising prices. This would lower demand until supply and demand were again in balance. If withdrawal support were replaced by other forms of support, this might affect the price level at which the market balanced. However, this longer-term effect is highly uncertain and in this paper we limit ourselves to an estimate of the initial maximum effect of the policy change. Our market model is uncomplicated and ignores the role of the retail sector and other elements in the chain between producer and consumer. However, we cannot conceive of realistic scenarios that result in higher estimates of consumption and health gain, and we would argue that the likely
Figures in parentheses are 95% uncertainty intervals. DALY
Life years gained per 100 000 person-years (aged 25
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for determining whether there is an effect but not suitable for
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increase in availability of fruits and vegetables, and its distribu-
tion over the population. The uncertainty resulting from the
Table 3 Estimated decline in incidence and projected aggregate annual health gain in the Dutch population that would
result from ending EU withdrawal support for fruits and vegetables

<table>
<thead>
<tr>
<th>Category</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths postponed (total population)</td>
<td>66 (39–103)</td>
<td>44 (25–71)</td>
</tr>
<tr>
<td>Life years gained (total population)</td>
<td>1867 (508–1358)</td>
<td>1167 (357–1605)</td>
</tr>
<tr>
<td>Life years gained per 100 000 person-years (aged 25+) years</td>
<td>15.8 (9.2–24.7)</td>
<td>10.6 (6.2–16.7)</td>
</tr>
<tr>
<td>DALYs gained (total population)</td>
<td>1080 (609–1732)</td>
<td>850 (467–1387)</td>
</tr>
<tr>
<td>DALYs gained per 100 000 person-years (aged 25+) years</td>
<td>19.6 (11.1–31.5)</td>
<td>14.8 (8.1–24.1)</td>
</tr>
<tr>
<td>Increase in life expectancy (days)</td>
<td>3.8 (2.2–5.9)</td>
<td>2.6 (1.5–4.2)</td>
</tr>
<tr>
<td>Increase in disability-adjusted life expectancy (DA-days)</td>
<td>4.5 (2.5–7.3)</td>
<td>3.6 (1.9–5.9)</td>
</tr>
</tbody>
</table>

Figures in parentheses are 95% uncertainty intervals. DALY = disability-adjusted life year; DA-day = disability-adjusted day
The Dutch population is just over 16 million people

Table 3 Estimated aggregate annual health gain in the Dutch population from ending EU withdrawal support for fruits
and vegetables under the assumption that all extra fruits and vegetables are consumed by those currently consuming
< 100 g per day

<table>
<thead>
<tr>
<th>Category</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life years gained per 100 000 person-years (aged 25+) years</td>
<td>27.7 (21.0–35.1)</td>
<td>19.6 (11.3–31.6)</td>
</tr>
<tr>
<td>DALYs gained per 100 000 person-years (aged 25+) years</td>
<td>33.4 (23.9–44.0)</td>
<td>26.0 (14.4–43.6)</td>
</tr>
<tr>
<td>Increase in life expectancy (days)</td>
<td>6.5 (4.9–8.3)</td>
<td>4.6 (2.7–7.5)</td>
</tr>
<tr>
<td>Increase in disability-adjusted life expectancy (DA-days)</td>
<td>7.6 (5.3–10.1)</td>
<td>6.0 (3.2–10.1)</td>
</tr>
</tbody>
</table>

Figures in parentheses are 95% uncertainty intervals. DALY = disability-adjusted life year; DA-day = disability-adjusted day

The effect of ending withdrawal support is between zero and the results of our study.

Uncertainty

Overall uncertainty in the estimates is high. Three important sources are the relative risks of disease, the amount of the increase in availability of fruits and vegetables, and its distribution over the population. The uncertainty resulting from the first two sources is included in the uncertainty intervals presented.

First, there are wide confidence intervals around the relative risk estimates linking the consumption of fruits and vegetables to disease. Epidemiological research in this area is difficult owing to difficulty in measuring intake. There is also a paucity of good meta-analyses. This in turn is due to the way results are reported in original studies. Most often the highest consumption quantile is compared with the lowest, which is appropriate for determining whether there is an effect but not suitable for estimating its magnitude as it disregards consumption levels and spread in intake, thus hampering comparability with other populations. For cancers we were able to use a meta-analysis, but for coronary heart disease and stroke we used a review which presents a ‘best guess’ and ‘conservative’ and ‘optimistic’ estimates. In consultation with one of the authors we tentatively interpreted the latter estimates as confidence intervals, after fitting them to a lognormal distribution. Finally, there is controversy over which type of studies are more suitable: case-control or cohort. The latter give lower estimates of effect. We used estimates for all studies combined as presented in the meta-analysis.

A second source of uncertainty is the amount of extra fruits and vegetables that would become available as a result of ending withdrawal subsidies. This depends on, among other factors, weather conditions, which vary by year.

Third, there is the question of who would consume the extra fruits and vegetables. In our model, most of the extra consumption falls to the groups that already consume relatively much. As an alternative, we created a model in which the lowest consumption group (i.e. those consuming <100 g per day) received all extra fruits and vegetables. This extreme assumption resulted in ~75% more health gain compared with the results above (table 3). Though the individuals concerned gain more, the effect on the total population remains modest.

Finally, the limited number of diseases included in the model might lead to underestimation of the health effects.
out entirely independently of the funder. The Department of Public Health at Erasmus MC has received several EU grants for research. Preliminary results of this study were presented to the Dutch National Congress of Public Health in April 2004.

Key points
- Although many Europeans consume less fruits and vegetables than recommended, EU policy results in the destruction of produce.
- This study aims to quantify the potential health impact of reforming the EU agricultural policy on fruits and vegetables.
- Ending withdrawal of ‘excess’ fruits and vegetables from the market could increase Dutch life expectancy by days.
- This reform is also likely to decrease socio-economic health inequalities.
- The EU should assess proposals to reform the Common Agricultural Policy for their impact on health.

References

Effects on socio-economic inequality
A related question is how the suggested reform would influence socio-economic inequalities in health. This depends on the difference in health gain of groups with different socio-economic status (SES), which in turn depends on three factors that may vary with SES: the current level of fruit and vegetable consumption, the corresponding burden of disease, and price-sensitivity. In the Netherlands, groups with lower SES consume less fruits and vegetables than those with higher SES (figure 2), and their burden of disease owing to cardiovascular disease and cancer is higher. A–F We found no data on differences in price-sensitivity by SES, but there are indications that price is a barrier to a healthier diet, especially in low-income groups. All three factors therefore indicate that the groups with lower SES stand to gain more than those with higher SES, so it seems likely that ending withdrawal subsidies for fruits and vegetables would reduce health inequalities. Quantification of this effect is possible but requires SES-specific data. Distributing the withdrawn fruits and vegetables to charity, which is intended but rarely enforced under current policy, would also reduce health inequalities.

Immediate maximum effect
The life table model does not have a factor ‘time’ in the sense that it presents all effects as immediate. In reality, it takes time for an increase in consumption of fruits and vegetables to result in a decline in incidence of disease, with prevalence and mortality lagging even more. Thus, the annual health gains presented here would materialize over the years. Their magnitude is not affected by the timelessness of the model.

Policy recommendations
A recent study concluded that the EU policy of price support for fruits and vegetables has adverse health effects and should be abandoned. G We attempted to quantify the health gain that reform might yield. The modest results presented here do not imply that CAP as a whole has a small influence on health in Europe. Rather, they can be taken to suggest that in order to give health interests due weight in the decision-making process, a comprehensive effort at quantification of the health effects of CAP could and should be undertaken. More generally, this paper illustrates an approach to quantification that can be used in health impact assessment.

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