

Veg Facts 2021: a briefing by the Peas Please initiative

Technical Report

Calculating consumption statistics using the National Diet and Nutrition Survey (NDNS)

Consumption estimates are based on secondary analysis which we conducted on the raw data of the National Diet and Nutrition Survey which is published by [Public Health England](#). The data which we analysed came from the National Diet and Nutrition Survey Results from Years 1-11 (combined) of the Rolling Programme (2008/2009-2018/2019) and published in 2020. The raw data is available to download [here](#).

This NDNS survey records what adults and children consume using a detailed, self-reported four-day food diary, including the amount and type of vegetables. It is nationally representative and the UK's best national source of dietary data.

The NDNS does not contain a variable for vegetable portion sizes. Vegetable only portion sizes were therefore calculated using the same methods as the NDNS to calculate portions of fruit and veg: i.e. the total, excluding the contribution of fruit. Weight of vegetables (in grams per person) was divided by 80 to arrive at the number of vegetable portions per person. To calculate portion sizes for children aged between five and ten years old, we used the same method as above, but instead used 50g as one portion, which is the mid-point in the 40-60g recommended for children aged 4-10 years in the [School Food Plan](#).

All means calculated for vegetable consumption were weighted to adjust for differences in sample selection and non-response.

Vegetable consumption by region

Data presented here look at consumption for population groups aged 11 years and over, comparing waves 5-8 to 9-11 (i.e. 2012-2016 to 2016-2019). One limitation of the data for waves 9-11 is that when broken down by region, the sample sizes for secondary school aged children are small for Scotland and Wales compared to England and Northern Ireland (see below). As a result, regional consumption data have not been split by age-group as with other consumption statistics in Veg Facts 2021.

Secondary school children (11-16y)			
England (n=367)	Scotland (n=26)	Wales (n=38)	N Ireland (n=98)

Vegetable consumption by income

The variables for income were not included in the raw data published for public use for waves 9-11 of the NDNS. As a result, these variables were purchased from NatCen by the Food Foundation for the purposes of conducting this analysis. We were provided with a lookup to match versions of the equivalised income variable (Eqvinc) onto the existing archived dataset. Eqvinc was grouped into deciles.

While we were not able to triangulate our results for the vegetable variable with NDNS data on fruit and vegetables consumption by income, as this information was not published for waves 9-11, the results are in line with previous NDNS analysis on income and fruit and vegetable consumption ([NDNS, yrs 1-9](#)). All our results show a significant trend with equivalised income, and we have presented the results, p-values, and confidence intervals (which do not overlap) for our analysis below.

Year 9 to 11

mean portions $P < 0.05$ - using equivalised income deciles

Q1 2.01 (1.75 to 2.28)

Q5 2.96 (2.64 to 3.28)

% eating <1 portion $P < 0.05$

Q1 16.46 (10.14 to 25.6)

Q5 4.67 (1.7 to 12.0)

Year 5 to 8

mean portions $P < 0.05$ - using equivalised income

Q1 2.23 (2.09 to 2.38)

Q5 2.84 (2.69 to 3.00)

% eating <1 portion $P < 0.05$

Q1 15.8 (13.0 to 19.4)

Q5 5.7 (4.0 to 8.6)

Vegetable consumption by ethnicity

One limitation of these data is that the majority of NDNS participants are White, with smaller sample sizes for other ethnicities. For waves 9-11 there were 55 Black or Black British respondents, 154 Asian or Asian British, and 32 of Mixed Ethnicity compared to 2,252 White participants. Vegetable consumption was therefore analysed for all those aged 11 years and older and not broken down further by age-group as the samples would have been too small.

Vegetable intake from foods by levels of processing

The NOVA classification system was used to group food entries in the NDNS dataset based on the degree of processing ([Monteiro et al, 2019](#)). Group 1 contains unprocessed foods or minimally processed foods that may be altered by processes to extend the life of unprocessed foods (e.g. drying, crushing or vacuum packing) but where the process does not involve the addition of sugar, salt, oils or other food substances. The second group contains processed culinary ingredients, including plant oils, animal fats, and sugars or syrups. Group 3 contains processed foods, further divided into processed food products and ultra-processed foods (Group 4). Processed foods are often [defined](#) as a combination of several unprocessed and processed ingredients, and ultra-processed a combination of processed foods and including ingredients not normally found in domestic recipes.

The total vegetable intake per person by foods from each NOVA group was then calculated and the proportion of vegetable intake that came from each NOVA group determined. For the purpose of this analysis, vegetable intake from unprocessed or minimally processed foods includes those categorised as NOVA group 1, as well as any vegetables that may have been combined with a Group 2 fat/oil but where the only other ingredient is vegetables e.g. tomatoes cooked in oil. Vegetable intake from processed foods includes those in NOVA group 3&4. Vegetable intake from ultra-processed foods include those categorised as NOVA group 4.

Vegetable intake from composite meals (homemade dishes) are classified separately as they combine foods from a number of NOVA groups. See table below for more information on foods in each NOVA group.

The NOVA food classification system

Food group and definition	Examples
<p>1 Unprocessed or minimally processed foods</p> <p>Unprocessed foods are foods of plant origin (leaves, stems, roots, tubers, fruits, nuts, seeds), or animal origin (meat, other flesh, tissue and organs, eggs, milk) distributed shortly after harvesting, gathering, slaughter, or husbanding. Minimally processed foods are unprocessed foods altered in ways that do not add or introduce any substance but may involve removing parts of the food. Minimal processes include cleaning, scrubbing, washing; winnowing, hulling, peeling, grinding, grating, squeezing, flaking; skinning, boning, carving, portioning, scaling, filleting; pressing, drying, skimming, pasteurizing, sterilizing; chilling, refrigerating, freezing, sealing, bottling, simple wrapping, vacuum- and gas-packing. Malting, which adds water, is a minimal process, as is fermenting, which adds living organisms, when it does not generate alcohol.</p>	<p>Fresh, chilled, frozen, vacuum-packed vegetables and fruits; grains (cereals) including all types of rice; fresh, frozen, and dried beans and other legumes (pulses), roots and tubers; fungi; dried fruits and freshly prepared or pasteurized non-reconstituted fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry, fish, and seafood; dried, fresh, pasteurized full-fat, low-fat, skimmed milk, and fermented milk such as plain yogurt; eggs; flours, "raw" pastas made from flour and water; teas, coffee, herbal infusions; tap, filtered, spring, mineral water.</p>
<p>2 Processed culinary ingredients</p> <p>Substances extracted and purified by industry from food constituents or obtained from nature. Preservatives, stabilizing or "purifying" agents, and other additives may be used.</p>	<p>Plant oils; animal fats; starches; sugars and syrups; salt.</p>
<p>3 Processed foods</p> <p>Manufactured by adding salt or sugar (or other culinary ingredient such as oil or vinegar) to foods to make them more durable or modify their palatability. Directly derived from foods and recognizable as versions of the original foods. Generally produced to be consumed as part of meals or dishes. Processes include canning and bottling, fermentation, and methods of preservation such as salting, salt-pickling, and curing.</p>	<p>Canned or bottled vegetables and legumes (pulses) preserved in brine or pickled; peeled or sliced fruits preserved in syrup; tinned whole or pieces of fish preserved in oil; salted nuts or seeds; non-reconstituted salted or cured processed meat and fish such as ham, bacon, and dried fish; cheeses made from milk, salt, and ferments; and breads made from flours, water, salt, and ferments.</p>
<p>4 Ultra-processed products</p> <p>Formulated mostly or entirely from substances derived from foods or other organic sources. Typically, they contain little or no whole foods. They are durable, convenient, packaged, branded, accessible, highly or ultra-palatable, often habit-forming. Typically not recognizable as versions of foods, although may imitate the appearance, shape, and sensory qualities of foods. Many ingredients are not available in retail outlets. Some ingredients are directly derived from foods, such as oils, fats, starches, sugars, and others are obtained by further processing of food constituents or synthesized from other organic sources. Numerically the majority of ingredients are preservatives and other additives such as stabilizers, emulsifiers, solvents, binders, bulkers, sweeteners, sensory enhancers, colors and flavors, and processing aids. Bulk may come from added air or water. Micronutrients may "fortify" the products. Most are designed to be consumed by themselves or in combination as snacks, or to replace freshly prepared dishes and meals based on unprocessed or minimally processed foods. Processes include hydrogenation, hydrolysis, extruding, molding, reshaping, preprocessing by frying, baking.</p>	<p>Chips (crisps) and many other types of sweet, fatty, or salty packaged snack products; ice-cream, chocolates, candy (confectionery); French fries (chips), burgers and hot dogs; poultry and fish nuggets or sticks (fingers); packaged breads, buns, cookies (biscuits); sweetened breakfast cereals; pastries, cakes, cake mixes; energy bars; preserves (jams), margarines; packaged desserts; canned, bottled, dehydrated, packaged soups, noodles; sauces; meat and yeast extracts; carbonated drinks, energy drinks; sugar-sweetened milk drinks including fruit yogurts; fruit and fruit nectar drinks; no-alcohol wine, beer; pre-prepared meat, fish, vegetable, cheese, pizza, pasta dishes; infant formulas, follow-on milks, other baby products; "health" and "slimming" products such as powdered or "fortified" meal and dish substitutes.</p>

Source: Moubarac et al, 2014

Top contributors to vegetable consumption by age group

We used the NDNS data to understand where the vegetables in adult's and children's diets come from – whether they are eating veg alone (raw, boiled, tinned etc.) or whether they are eating them as part of composite or processed foods – like pizza or beans.

The NDNS dietary data does not always break down food entries into individual ingredients, so to obtain these figures we performed secondary analysis based on certain assumptions. In our analysis of the data we did the following:

1. Each individual food entry in the NDNS dataset is classified into one of more than 150 sub food group classifications e.g. “carrots – not raw”. In the dataset the most detailed description for each entry is the Food Name e.g. “Cheese & Tomato pizza, any base, retail” or “Baked beans in tomato sauce” which then comes under the sub food group (Pizza, Baked Beans).
2. The amount of veg in each food entry is listed as a variable in the NDNS dataset. More information on how the nutritional information for each food entry is obtained and their assumptions can be found [here](#).
3. Total veg were calculated in the same way the NDNS calculates fruit&veg in weight (minus the fruit) so the sum of: Beans + Brassicaceae + Otherveg + Tomatoes + Tomato puree + YellowRedGreen. Again, this variable was already in the dataset.
4. We calculated the percentage contribution of the vegetables in each sub- food group to total daily vegetable intake (in grams).
5. We then ranked the sub-food groups based on their overall mean contribution. We grouped sources which were small individual contributors but which included vegetables eaten raw, boiled, pickled steamed or baked or as ingredients in home-made dishes into a single category “Other vegetables including homemade dishes”.

How much veg is in the supply chain?

The 5-a-day and 7-a-day requirements for the population were based on ONS mid population figures for 2019-2020. Adult fruit and veg portion sizes of 80g were applied to 11+yrs, 60g for 8-10yrs and 40g for 1-7yr old's (from school food plan 2015 recommendation of portion sizes to be 40-60g for 6-10 year old's). Under 1's were not included as they are pre-dominantly milk fed. Portion size was multiplied by recommendation (5 or 7-a-day) for daily and then annual amount per person and then for population groups. These were then summed to give overall fruit and vegetable requirement for the current UK and individual countries within the UK. Vegetable requirements were calculated as being half of the fruit and vegetable requirement.

The most up to date Defra Horticulture Statistics (Horticulture Statistics 2019, published July 2020) were used to calculate total supply of veg by adding veg production (no potatoes) and imported veg and taking away exports.

In order for there to be enough veg in the supply chain for everyone to meet 5 or 7-a -day requirements waste was factored in. With the most up to date information we worked with WRAP in 2020 to calculate fruit and veg waste along the supply chain. It was not possible to separate data for fruit and veg for the supply chain so the two have been combined. Waste levels along the supply chain were calculated as 30.6% and were based on the following calculations and assumptions:

1. Farm waste was excluded – fruit and veg wasted on farm was not included as it is already factored into farm gate availability stats from Defra. However, it is worth noting that it would be possible to increase production from UK farms by reducing fruit and veg wasted on farm.
2. Manufacturing waste – consisted of 144kt total fruit and veg waste (this doesn't include sludges- waste, soil) plus 172kt of fresh produce that went to animal feed from manufacture.
3. Retailer waste – the fresh produce waste levels of 5 retailers were collected (Tesco, Aldi, Lidl, Asda and Iceland) and these averaged at 31%. This percentage was then applied to the estimate of food waste from retail (277kt in total). This gave an estimate of circa 110kt for fresh produce waste.
4. Out of home – From the 'Overview of Waste in the UK Hospitality and Food Service Sector 2013' report waste levels of 15% avoidable and 15% unavoidable were applied to the latest estimate for the sector producing a figure of around 165K tonnes of avoidable fresh produce waste, and the same tonnage again for unavoidable. Out of Home venues prioritised by WRAP for reducing F&V waste are restaurants, pubs, hotels and education.
5. Household waste – Avoidable and unavoidable calculated from here wrap household food waste, 2012 (veg waste-potatoes+processed veg+fruit+processed fruit) see below:

Table 1: Food foundation and WRAP calculation of UK fruit and veg waste

		Realistic levels of F&V waste estimate 2020	Million Metric Tonnes
Supply chain	Farm	not included	n/a

	Manufacturing	Fruit and veg food waste	144,000
		Fruit and veg to animal feed	172,000
	Retail		110,000
	Out of Home	avoidable + unavoidable combined	330,000
		Total supply chain waste	756,000
Household			890,000
	Processed veg waste (Coleslaw and other veg)		91,000
	Total veg (veg-potatoes +processed veg)		981,000
	Fruit (including bananas and oranges)		920,000
	Add processed fruit		20,000
		Total fruit (fruit + processed fruit)	940,000
		Total household	1,921,000
	Total waste (household & supply chain)		2,677,000
		Total supply	%Total supply
		8,748,800	30.6%

For the purposes of the fruit and veg requirement we halved the realistic waste estimate of 30.6% to 15.3% to be in line with the Sustainable Development Goal for halving of food waste by 2030.

To calculate the gap between current production and target consumption we compared a 5 or 7-a-day requirement plus 15.3% waste to total supply.

Veg Box survey

Following on from our first veg box [survey in April 2020](#), we conducted a second survey of 99 veg box schemes to cover the period from February 2020-November 2020. The sample was different from the first veg box survey, though with some overlap. 75% of the box schemes who completed the second survey sold less than 300 boxes a week, 24% 300-2000 boxes, and 1% over 2000.

How much veg do we eat out of the home?

The Living Costs and Food Survey (LCFS) collects information on spending patterns and the cost of living that reflect household budgets. It is conducted throughout the year by the Office of National Statistics, across the whole of the UK, and is the most significant public survey on household spending in the UK. Information on food purchases is included for use by DEFRA. Respondents complete a face-to-face interview with questions on regular items of household expenditure and income details, with individuals aged 16 or over asked to keep a diary of daily expenditure for two weeks.

For meals eaten out, diary keepers record itemized lists of meal components. Food items are coded to a more detailed level than other categories. This enables DEFRA to carry out nutritional analysis. These detailed codes are then collapsed into the COICOP food codes for other customers. For example, bread is originally coded to eight different bread codes, such as sliced white, unsliced white, wholemeal, etc.

We conducted secondary analysis on the LCFS data, based on average consumption patterns. Individuals living in UK households purchased an average of 2,119 calories per day in 2019. Of these, 225 kcals per day came from foods purchased for consumption outside of the home (including takeaways): 10.6% of total energy purchases. However, on average only 4% of an average individual's vegetable purchases (7g of 176) came from food eaten outside the home as demonstrated in Table 2.

If 10.6% of kcals are eaten out of the home this amounts to 2.2 meals per week eaten out of the home. From these meal occasions an average person gets 7g of veg, or 49g per person per week. A portion of veg amounts to 80g. For every 2.2 meals eaten out the average citizen gets 49g of veg, with one meal providing 22g of veg.

Table 2. Average energy purchases and vegetable purchases, 2019

	Energy		Vegetable purchases	
	Kcals/day	% of total	g/day	% of total
Household consumption	1893.7	89.4	169.6	96.0
Food eaten out	224.8	10.6	7	4.0
Total	2118.5	100.0	176.6	100

Trends in purchasing vegetables

We updated the graph and calculations undertaken for Veg Facts 2016, with data from the intervening five years (2014-2019). As there have been several iterations of nationally representative surveys looking at household purchasing patterns, this used adjusted data from the National Food Survey which ran 1974-2000, the Expenditure and Food Survey from 2001-2 to 2007, and the Living Costs and Food Survey from 2008 onwards. We calculated the data from g/per/week of vegetable consumption into g/per/day by dividing by 7.

The contribution of vegetables to micronutrient intakes

We used the NDNS to identify the proportion of adults, by age group, who were below the Lower Reference Nutrient Intake (LRNI) for those micronutrients where on average >10% of daily intake comes from vegetables (excluding potatoes). The LRNI is the amount of a nutrient that is enough for only a small number of people in a group who have low requirements (2.5%) i.e. 97.5% of the population will need more than the LRNI. We looked at the % below the LRNI without supplements. One limitation of these data is that the NDNS recommends caution when using LRNI's to assess adequacy of intakes using NDNS data. This is because the NDNS method of capturing intake data using 4-day diet diaries will include a margin of error for capturing intakes for micronutrients, which are often required in only very small amounts with bodily stores of certain micronutrients playing an important role in homeostasis.

The contribution of veg to fibre intakes

We used our list of the top ten most consumed vegetables based on NDNS data for waves 9-11 (see above) to estimate their contribution towards AOAC fibre intake. AOAC fibre comprises the total amount of non-digestible polysaccharides, and includes e.g. lignin and resistant starches, measured with a set of methods developed by the Association of Analytical Chemists (AOAC). It is commonly used as a method for measuring fibre and the government recommendation for fibre intake use AOAC methodology.

Table: Contribution of top 10 veg contributors to recommended AOAC fibre intake in adults

Adults >16y	AOAC fibre		% of recommended AOAC fibre intake*	% of actual AOAC fibre intake
	Mean g/day	Median g/day		
Other vegetables including homemade dishes**	1.4	0.9	4.5	6.8
Salad and other raw vegetables	0.4	0.2	1.4	2.2
Tomatoes raw	0.2	0.0	0.5	0.8
Leafy green vegetables not raw	0.4	0.0	1.2	1.9
Tomatoes not raw	0.2	0.0	0.5	0.7
Baked beans	0.7	0.0	2.5	3.7
Carrots not raw	0.3	0.1	1.1	1.7
Peas not raw	0.4	0.0	1.3	2.1
Sauces & pickles	0.4	0.3	1.4	2.2
Beans and pulses including ready meal & homemade dishes**	0.7	0.0	2.2	2.8
Total			16.6%	24.9%

* Recommended AOAC fibre intake for adults: 30g/day

**These groups include homemade and ready meals dishes where other non-veg ingredients would contribute to fibre content, so it is difficult to separate the contribution of veg which can be seen as a limitation.

Better for health, better for the environment

The data quoted in this section is based on modelling work undertaken by the Sustainable and Healthy Food Systems (SHEFS) research consortium, funded by the Wellcome Trust. The Food Foundation are co-investigators. More information on the modelling undertaken as part of calculating the environmental and health impact of increasing consumption in the UK to 5-a-day can be found [here](#), in the series of policy briefings produced to describe the findings of the SHEFS research.

Of the four scenarios modelled by SHEFS, the best pathway to 5-a-day in terms of life expectancy and carbon footprint reduction, was one where vegetable intake (rather than both fruit and vegetable intake) increased, and for these vegetables to come from the same vegetable groups that are currently imported and home grown (Veg Same model) rather than home-grown only (Veg Home model).

This is because in the Veg Same and Veg UK pathways modelled, the extra vegetable consumption comes from replacing meat (beef, lamb, pork and poultry) with vegetables on a

per kcal basis. Because UK vegetables tend to be lower in calories than those that are imported, Veg UK displaces less meat than Veg Same in the model. This means that less meat production is needed for the Veg Same pathway, contributing to its slightly lower carbon footprint.

For the economy

The most recent Defra [Horticulture statistics 2020](#) estimated that vegetable production (2,422,900 million tonnes) was worth £1.48 billion. These figures were used to calculate the value per tonne. The amount production would have to increase, at the same production to supply ratio as currently, was calculated by working out the difference between current supply and the 5 and 7-a-day requirements.

5-a-day Requirement	F&V	Fruit	Veg
UK Production as % of supply (from tab 3):	36%	16%	53%
Supply meets Optimal demand at (5 a day from Tab 2): (MT/year)	9,145,986	4,572,993	4,572,993
Realistic levels of supply chain and household food waste halved in line with SDG (tab 4): (%)	15.30	15.30	15.30
Total supply needed (optimal demand + SDG goal waste): (MT/year)	10,797,997	5,398,999	5,398,999
Increase from current supply to meet optimal demand : (MT/year)	2,049,197	1,240,699	808,499
Opportunity for UK grown: (MT/year) if ratio of supply remains constant	630,546	203,814	426,732
Current UK Production	3,106,000	683,100	2,422,900
Total UK grown if opportunity seized	3,736,546	886,914	2,849,632
% increase in UK supply to meet opportunity	20	29.8	17.6
Value of extra fruit and veg production in UK (billion £)	0.522	0.261	0.261

7-a-day (current Eatwell guide, PHE 2016)	F&V	Fruit	Veg
UK Production as % of supply (from tab 3):	36%	16%	53%
Supply meets Optimal demand at (7 a day from Tab 2): (MT/year)	12,804,380	6,402,190	6,402,190
Realistic levels of supply chain and household food waste halved in line with SDG (tab 4): (%)	15.30	15.30	15.30
Total supply needed (optimal demand + SDG goal waste): (MT/year)	15,117,196	7,558,598	7,558,598
Increase from current supply to meet optimal demand: (MT/year)	6,368,396	3,400,298	2,968,098
Opportunity for UK grown: (MT/year)	2,125,164	558,580	1,566,584

Current UK Production	3,106,000	683,100	2,422,900
Total UK grown if opportunity seized	5,231,164	1,241,680	3,989,484
% increase in UK supply to meet opportunity	68.4	81.8	64.7
Value of extra fruit and veg production in UK (billion £)	1.7	0.7	1.0

Making veg more available – citizen research task

180 Veg Advocates from across the UK have been recruited as part of the Peas Please project. They are acting as individual ‘agents of change’ to help us in our mission of increasing the UK’s vegetable consumption.

Working with the Peas Please Veg Advocates we undertook a citizen research survey. Our Advocates were asked to record ‘snapshots’ of the food available by visiting different convenience stores on local high streets and in petrol stations across the UK over the course of two weeks. A total of 16 different stores in nine locations were visited between April 20th and May 4th 2021. Results were recorded using Typeform survey software, with Advocates asked to complete a set of multiple-choice questions and with the option to upload photos.

Store locations were recorded as follows:

Location	
Liverpool	2
Glasgow (Scotland)	1
Hampshire	3
Lancashire	3
Birmingham	1
Londonderry (NI)	1
Comber (NI)	1
Rosyth (Scotland)	1
Leeds	3

Seven petrol station food outlets, six convenience stores and three convenience stores affiliated or branded as part of larger retailers were visited.