**Supplemental Material 1. Determining compliance with the Healthgrain whole-grain food definition**

The Swedish Food Agency’s (SFA) national food composition database (Livsmedelsdatabasen, version Riksmaten adults 2010-11) was utilised to determine compliance of Swedish foods with the Healthgrain whole-grain food definition. This version of the food composition database was developed as a food list to be used in conjunction with the Swedish dietary survey, Riksmaten adults 2010-11, for the purpose of dietary intake analysis. This database will hereafter be referred to as the Riksmaten adults food list or survey food list.

The Riksmaten adults food list contains 1,909 common name food items that were consumed by the Swedish population at the time of the survey. Composition of food items were determined through analysed or calculated methods. The process to determine compliance is described in detail below and outlined in Supplemental Figure 1. In brief, methods were adapted from a study previously published by the authors(1) and involved calculating the percentage of whole-grain content on a dry weight basis for all food items, determining the whole-grain and refined grain ingredient content, and finally identifying if foods containing whole grain were classified as “healthy” based on the Keyhole criteria.

***Step 1 - Calculating whole-grain intake on a dry weight basis***

Initially, whole-grain content of food items were retrieved from the Riksmaten adults food list as the grams of whole grain per 100g of the food item (g WG/100g). However, within this survey food list, products containing corn kernels or corn cobs as an ingredient were identified as containing whole grain. Under the Swedish definition of whole grain(2), corn irrespective of its form is classified as a whole grain. Whereas fresh corn/corn kernels are classified as a “vegetable” rather than a “whole grain” in Australia. For comparison purposes the whole-grain content within Swedish food items were recalculated based on the exclusion of whole grain derived from corn kernels and/or corn cobs. This was achieved through analysing calculated ingredients of foods items and subtracting the corresponding corn proportion from the total whole-grain content. Using the newly calculated values, whole-grain content on a dry weight basis for all food items were determined. This value was initially calculated as the grams of whole grain per 100 grams dry weight of food (g/100g dry weight), then converted to a percentage of dry weight for consistency and comparability with the Healthgrain whole-grain food definition(3). Calculations utilised the newly calculated whole-grain content (g WG/100g) and water content (g/100g) of food items provided in survey food list. If the food item contained ≥30% whole grain on a dry weight basis it was identified as complying with the first criteria point of the Healthgrain definition.

***Step 2-4 - Determination of whole-grain and refined grain ingredients***

The systematic method used to determine whole-grain and refined grain ingredient content is outlined in Supplemental Figure 2. The following process was applied to all food items within the Riksmaten adults food list.

Step 2: If a food item contained >50% whole grain on a dry weight basis it was identified as containing more whole-grain than refined grain ingredients, and therefore complying with the second criteria point of the Healthgrain definition.

Step 3: Food items containing 30-50% whole grain on a dry weight basis were analysed through various methods to determine the whole-grain and refined grain content, including use of calculated ingredients, product ingredient lists, information on product labelling, a recipe-based approach, or professional judgement.

Step 3a: Firstly, if the nutrient composition of the food item was determined through calculated ingredients (i.e. the ingredients of the food item are listed, along with their corresponding weights), and these ingredients were in a raw/basic form (step 3b), then the whole-grain and refined grain proportions were calculated using the weight of ingredients. If the ingredients were not in a raw/basic form, but raw/basic ingredients of the calculated ingredient were available (step 3c), the grain proportions were again calculated using the weight of ingredients (firstly to determine content of the calculated ingredient, then to determine content of the food item). Alternatively, if nutrient composition of the food item was not determined through calculated methods, or ingredients of calculated ingredients were not in a raw/basic form, the specific food product/s of the food item (if available) were analysed (see step 4a).

Step 3b/3c: described above.

Step 4a: If 1) the specific food product/s linked to the food item, 2) information on the specific product/s was provided (e.g. copy of the product packaging) (step 4b), and 3) whole and refined grain proportions could be determined from the product ingredient list or information about whole-grain percentage was provided on the labelling (step 4ci), then this information was used to determine if the food item contained more whole-grain than refined grain ingredients. If the whole and refined grain proportions were unable to be determined from the product ingredient list, then professional judgement was used to make an educated decision.

If the specific food product/s linked to the food item was provided (step 4a) but information on the specific product was not available (step 4b) and a similar product could not be identified through online searching (step 4cii), then whole and refined grain content was determined through a recipe-based approach. However, if a similar product could be identified through online searching (step 4cii) then the steps outlined for determination based on product ingredient list were followed (step4ci).

Alternatively, if specific food product/s of the food item are not provided (step 4a), then whole and refined grain content were determined through a recipe-based approach or use of professional judgement to make an educated decision.

Step 4b/4ci/4cii: described above.

***Step 5 - Determination of “Healthy foods”***

The Healthgrain whole-grain food definition recommends that whole-grain foods should meet accepted standards for ‘healthy foods’ based on local regulations. In Sweden, this refers to compliance with Keyhole criteria. The Keyhole criteria differs for each food group and the products within each group e.g. under the ‘Flour, grains and rice’ food group, ‘Breakfast cereals and muesli’ products have criteria around sugars, added sugars, fibre, whole grain, salt and fat, whereas ‘Rice’ products only have criteria around fibre and whole grain. As such, Keyhole criteria was manually applied to each food containing whole grain within the Riksmaten adults food list. This was achieved utilising relevant nutrient content data provided in the survey food list. Food items were classified into food groups based on the pre-determined classification provided within the survey food list and were assessed against the relevant Keyhole criteria. For example, a meatball food item containing whole grain derived from a breadcrumb ingredient and classified under the ‘Meat products meat dishes’ food group was assessed against criteria for the ‘meat and meat products: raw or edible products of chopped or ground meat’ food group of the Keyhole criteria.

Under the ‘Flour, grains and rice: breakfast cereals and muesli’ food group and the ‘Vegetables, fruits, berries and nuts: potatoes, root vegetables, legumes and other vegetables’ food group, a criterion around added sugars is present. However, within the survey food list, values for added sugars were not available, and it was not possible to obtain these values through other methods. For these reasons, any Keyhole criteria surrounding added sugar content was removed for the purposes of analysis.

Additionally, a criterion whereby trans-fat must not exceed 2g/100g was applied across all food groups, however, trans-fat content was not available for all food items within the survey food list. As shown in the Swedish Market Basket 2010 study(4), the estimated exposure to trans-fatty acids had decreased from 1.9g/person/day in 2005 to 1.7g/person/day, equating to 0.5% of energy and is well below the World Health Organisation recommendation of <1% energy from trans-fat(5). In the Swedish Market Basket 2015 study(6), this value dropped even further to 1.0g/person/day. Due to the minimal amounts of trans-fatty acids within foods and the decreasing trend, it is more difficult to obtain relevant content data for all foods. Therefore, an educated assumption that trans-fat content would not exceed this amount was made based on similar products and the unlikelihood that this amount would be present in any products containing whole grain.

Furthermore, many Keyhole food groups contain a criterion surrounding total sugars. However, the value for total sugar content was not available for a large majority of food items, and therefore a systematic method to determine totals sugars of each food item was developed. The systematic method is outlined in Supplemental Figure 3. Briefly, total sugar values were calculated through summating individual sugar contents (i.e. glucose, sucrose, fructose, lactose and maltose). However, if one or more individual sugar contents were not available, total sugar contents were obtained based on older analysis of the food item, older analysis of calculated ingredients, or from information of specific food product/s or similar/matched items to the food item e.g. the carbohydrate from sugars value in the nutrition information panel on product packaging. Supplemental Table 1 describes the number of food items that utilised each method to determine total sugar content.

It is important to note that Keyhole criteria was only available for a select number of food groups and food products under these groups, therefore if a food item did not fall under a Keyhole food group, the classification of meeting Keyhole criteria was determined through professional judgement; either matching to Keyhole criteria of an assumed similar food item or making an educated assumption. Supplemental Table 2 outlines the number of food items determined by each method. A list of Keyhole criteria for each food group is provided elsewhere(7).

***Compliance with the Healthgrain definition***

Compliance of food items within the Riksmaten adults food list with all three criteria points of the Healthgrain definition was low. Supplemental Figure 4 provides an overview of compliance with each criterion. Of the 1909 food items within the Riksmaten adults food list, 155 items were whole-grain containing after exclusion of corn. Of these, 88 items contained ≥30% whole grain on a dry weight basis with 85 items also containing more whole grain than refined grain. From these, only 29 items met Keyhole criteria. Therefore 155, 51, 85 and 29 food items were included in approach 1a, 1b, 2a and 2b respectively.

***Supplemental Figure 1.*** *Outline of the process to determine compliance of food items in the Riksmaten adults 2010-11 food list with the Healthgrain whole-grain food definition*

Step 1. Does the food item contain ≥30% whole grain on a dry weight basis?

No

The food is disregarded for this purpose

Yes

No

No

Determine whole-grain and refined grain content using a recipe-based approach OR use professional judgement to make an educated decision on whole and refined grain content

Step 4b. Is specific product information provided e.g. copy of product packaging?

Step 4cii. Can a similar product be identified through online searching?

Step 4a. Is a specific food product/s of the food item provided or is there information to be matched to another food item?

Yes

Calculate whole-grain and refined grain content based on weight of ingredients

No

Step 3c. Are the calculated ingredients based on raw/basic ingredients?

Yes

No

Calculate whole-grain and refined grain content based on weight of ingredients

Step 3b. Is the calculation based on raw/basic ingredients?

Step 3a. Is the nutrient composition of the food item determined through calculated methods?

Yes

Yes

Assume the food contains more whole grain than refined grain

Step 2. Does the food item contain >50% whole grain on a dry weight basis?

Yes

No

No

Yes

Step 4ci. Can whole-grain and refined grain content be accurately determined based on product ingredient list or whole-grain percentage labelling?

Yes

No

Yes

No

Able to determine if the product contains more whole-grain than refined grain ingredients

Determine whole-grain and refined grain content using a recipe-based approach OR use professional judgement to make an educated decision on whole and refined grain content (where product ingredient list is available)

***Supplemental Figure 2****. Schematic diagram of the process to determine whole-grain and refined grain composition of foods within the Swedish national food composition database (version: Riksmaten adults 2010-11)*

Yes

Sum all individual sugar content values to determine total sugars

Are all individual sugar content values available?

***Supplemental Figure 3****. Schematic diagram of the process to determine total sugar content of food items within the Swedish national food composition database (version: Riksmaten Adults 2010-11)*

\* If there are multiple ingredients, need to calculate total sugars in relation to the weight of ingredients

No

No

No

No

No

Yes

Yes

Yes

Yes

Yes

Use sugar content values from this information

Yes

Yes

No

No

No

No

No

Yes

Yes

Use these sugar values

Is the calculation based on raw/basic ingredients?\*

Is the nutrient composition of the food item determined through calculated methods?

Use information from a similar product through online searching

Is specific product information provided e.g. copy of product packaging?

Use sugar content values from matched food item

Is there information to be matched to another food item?

Can total sugar content be determined from this information?

Use these sugar values

Is a specific food product/s of the food item provided?

Is information on individual sugar content values from earlier analysis available?

Are the calculated ingredients based on raw/basic ingredients?\*

Is information on individual sugar content values from earlier analysis available?

1909 items in Riksmaten adults food list

196 items contain any amount of whole grain (including corn)

1754 items do not contain any amount of whole grain

155 items contain any amount of whole grain

(after exclusion of fresh corn)

67 items contain <30% whole grain on a dry weight basis

88 items contain ≥30% whole grain on a dry weight basis

3 items contain more refined grain than whole-grain ingredients

85 items contain more whole-grain than refined grain ingredients

3 items do not meet Keyhole criteria

0 items meet Keyhole criteria

56 items do not meet Keyhole criteria

29 items meet Keyhole criteria

22 items meet Keyhole criteria

45 items do not meet Keyhole criteria

***Supplemental Figure 4****. Schematic diagram of the compliance of Riksmaten adults food list items with criteria outlined in the Healthgrain whole-grain food definition*

**Supplemental Table 1.** Method of calculating total sugar content for food items containing whole grain

|  |  |
| --- | --- |
| **Method of calculating total sugar content value** | **Number of food items** |
| Summating individual sugar contents  (glucose, sucrose, fructose, lactose and maltose) | 116 |
| Sugar contents imputed based on older analysis of food item | 4 |
| Total sugar content imputed from product nutrition information panel of specific product for food item (provided in system or through online search) | 13 |
| Total sugar content imputed from nutrition information panel of similar product available in the current market | 4 |
| Total sugar content determined from calculated ingredients of food item | 14 |
| Individual/total sugar content based on another food item as specified in the system | 4 |

**Supplemental Table 2.** Method to determine compliance of select food items containing whole grain to Keyhole criteria

|  |  |
| --- | --- |
| **Method of keyhole criteria compliance** | **Number of food items** |
| No direct match to Keyhole food group OR  no suitable Keyhole food group for linking – professional judgement\* | 14 |
| Gruel items - Base on criteria for porridge | 3 |
| Rice cracker items - Base on gluten free bread criteria | 4 |
| Rice dish items - Base on rice criteria | 1 |

\*Professional judgement – for biscuit, muffin, cake, dessert and crisp/popcorn food items. Assume they are classified as ‘unhealthy’ and do not meet Keyhole criteria due to high content in fat, sugar and/or salt.

**Supplemental Table 3.** Regression models used in linear regression analyses for various CVD health outcomes measures\*

|  |  |  |  |
| --- | --- | --- | --- |
| **Australian data** | | **Swedish data** | |
| **Outcome variable** | **Confounding variables used in regression model** | **Outcome variable** | **Confounding variables used in regression model** |
| BMI, body weight, WC, WHtR | Age + sex + energy intake + education + physical activity + smoking status | BMI, body weight, WC, WHtR, WHR | Age + sex + energy intake + education + physical activity + smoking status |
| SBP, DBP | Age + sex + energy intake + education + physical activity + smoking status + sodium intake + potassium intake + BMI | CRP | Age + sex + energy intake + education + physical activity + smoking status + SFA intake + PUFA intake + MUFA intake + alcohol intake + BMI |
| Total cholesterol, LDL-cholesterol, HDL-cholesterol, Fasting TG, ApoB, CRP | Age + sex + energy intake + education + physical activity + smoking status + SFA intake + PUFA intake + MUFA intake + trans-fat intake + alcohol intake + lipid lowering medication + BMI |  |  |
| Fasting blood glucose, HbA1c | Age + sex + energy intake + education + physical activity + smoking status + free sugar intake + BMI |  |  |

\* ApoB: apolipoprotein B; CRP: C-reactive protein; DBP: diastolic blood pressure; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; SBP: systolic blood pressure; SFA: saturated fatty acid; TG: triglycerides; WC: waist circumference; WHtR: waist-to-height ratio

**Supplemental Table 4.** Demographic characteristics by categories of whole-grain intake for Australian adults (n=10,802,620 for all approaches) [unweighted n=2,412]\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Whole-grain intake** | | | | | **p-value**† |
|  | **Non-consumers** | **Q1** | **Q2** | **Q3** | **Q4** |  |
| **Approach 1a** | | | | | | |
| n | 2,466,413 | 2,098,888 | 2,070,749 | 2,083,095 | 2,083,475 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 8.5 | 32.2 | 56.4 | 101.6 |  |
| Age‡§ | 44.8 (1.1)A | 47.4 (1.2)AB | 51.0 (1.3)BC | 51.6 (1.0)BC | 52.8 (1.1)C | <0.001 |
| Female (%)‖‖ | 50.4 (3.5)A | 45.3 (4.5)A | 51.0 (3.2)A | 52.0 (3.3)A | 46.3 (3.6)A | 0.66 |
| Energy intake (kJ/day)‡¶ | 9503 (214)AB | 10425 (293)BC | 10521 (261)C | 10123 (243)BC | 9123 (175)A | <0.001 |
| Sodium intake (mg/day)‡\*\* | 2809 (89)A | 2892 (125)A | 2624 (80)A | 2634 (67)A | 2560 (87)A | 0.12 |
| Potassium intake (mg/day)‡\*\* | 2948 (64)A | 3323 (140)AB | 3368 (78)B | 3350 (71)B | 3502 (54)B | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 34.5 (0.8)B | 33.4 (0.8)B | 32.7 (0.8)AB | 32.6 (0.8)B | 29.4 (0.7)A | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.0 (0.5)A | 13.0 (0.6)A | 14.4 (0.5)A | 13.8 (0.4)A | 14.7 (0.5)A | 0.12 |
| Monounsaturated fat intake (g/day)‡\*\* | 34.3 (0.7)B | 33.7 (1.0)AB | 34.1 (0.8)B | 32.3 (0.6)AB | 30.7 (0.7)A | <0.001 |
| Trans fat intake (mg/day)‡\*\* | 1778 (68)A | 1702 (73)AB | 1602 (67)AB | 1627 (59)AB | 1451 (76)B | 0.009 |
| Free sugar intake (% energy)‡¶ | 11.1 (0.5)A | 10.9 (0.7)AB | 10.0 (0.4)AB | 10.3 (0.5)AB | 8.7 (0.4)B | 0.002 |
| Alcohol intake (g/day)‡\*\* | 17.2 (1.9)AB | 21.5 (2.6)A | 18.3 (1.7)A | 10.1 (1.4)C | 11.4 (1.2)BC | <0.001 |
| University graduate (%)‖‖ | 27.0 (3.5)A | 35.1 (4.1)A | 33.1 (3.0)A | 32.5 (2.8)A | 32.8 (3.8)A | 0.49 |
| Current smoker (%)‖‖ | 15.9 (2.6)A | 16.7 (2.9)A | 11.7 (2.0)A | 9.1 (2.7)A | 8.8 (1.8)A | 0.07 |
| Physically active (%)‖‖ | 79.0 (2.9)A | 87.1 (1.8)A | 86.5 (2.2)A | 83.4 (2.2)A | 82.2 (2.6)A | 0.10 |
| Using lipid medication (%)‖‖ | 9.2 (1.7)AB | 9.6 (1.8)AB | 13.1 (1.9)ABC | 15.2 (2.4)ABC | 21.0 (3.0)C | <0.001 |
| **Approach 1b** | | | | | | |
| n | 2,878,439 | 1,982,726 | 1,982,788 | 1,978,306 | 1,980,361 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 8.5 | 33.2 | 56.4 | 102.2 |  |
| Age‡§ | 41.7 (1.1)A | 44.1 (1.4)AB | 48.3 (1.3)B | 49.2 (1.4)B | 49.2 (1.4)B | <0.001 |
| Female (%)‖‖ | 48.2 (3.4)A | 45.3 (4.3)A | 53.6 (3.3)A | 51.3 (3.5)A | 47.2 (3.9)A | 0.62 |
| Energy intake (kJ/day)‡¶ | 9551 (188)A | 10786 (341)B | 10434 (239)B | 9900 (221)AB | 9114 (181)A | <0.001 |
| Sodium intake (mg/day)‡\*\* | 2880 (100)A | 2755 (106)A | 2630 (74)A | 2643 (70)A | 2552 (91)A | 0.09 |
| Potassium intake (mg/day)‡\*\* | 3033 (92)A | 3288 (121)AB | 3338 (80)AB | 3369 (74)AB | 3515 (59)B | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 34.9 (0.8)A | 33.3 (0.8)A | 32.5 (0.8)A | 32.2 (0.8)A | 29.1 (0.7) | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.1 (0.5)A | 12.7 (0.6)A | 14.3 (0.5)A | 14.3 (0.5)A | 14.6 (0.5)A | 0.06 |
| Monounsaturated fat intake (g/day)‡\*\* | 34.2 (0.7)B | 34.1 (1.1)B | 33.4 (0.7)AB | 32.6 (0.7)AB | 30.6 (0.8)A | <0.001 |
| Trans fat intake (mg/day)‡\*\* | 1860 (73)A | 1609 (75)AB | 1618 (69)AB | 1610 (52)A | 1388 (54)B | <0.001 |
| Free sugar intake (% energy)‡¶ | 11.3 (0.5)A | 10.7 (0.7)AB | 9.8 (0.4)AB | 10.3 (0.5)AB | 8.7 (0.4)B | 0.003 |
| Alcohol intake (g/day)‡\*\* | 16.3 (1.7)AB | 23.2 (2.8)A | 17.9 (1.8)A | 9.4 (1.3)C | 11.8 (1.2)BC | <0.001 |
| University graduate (%)‖‖ | 28.0 (3.2)A | 31.9 (3.9)A | 34.6 (3.1)A | 33.2 (3.0)A | 33.7 (4.0)A | 0.59 |
| Current smoker (%)‖‖ | 17.2 (2.3)A | 15.7 (3.0)A | 10.5 (2.2)A | 9.0 (2.7)A | 8.5 (1.8)A | 0.03 |
| Physically active (%)‖‖ | 79.6 (2.6)A | 88.0 (2.1)A | 85.6 (2.1)A | 84.0 (2.2)A | 81.7 (2.6)A | 0.10 |
| Using lipid medication (%)‖‖ | 9.6 (1.6)AB | 9.9 (1.7)AB | 12.5 (1.8)ABC | 16.2 (2.6)ABC | 20.8 (3.0)C | <0.001 |
| **Approach 2a** | | | | | | |
| n | 4,723,272 | 1,521,303 | 1,532,125 | 1,506,423 | 1,519,497 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 19.6 | 39.0 | 59.6 | 104.1 |  |
| Age‡§ | 43.2 (0.7)A | 47.5 (1.8)AB | 47.0 (1.7)AB | 49.8 (1.7)B | 49.0 (1.4)B | <0.001 |
| Female (%)‖‖ | 47.5 (2.2)A | 54.0 (4.7)A | 51.7 (3.6)A | 49.0 (3.4)A | 46.3 (4.4)A | 0.63 |
| Energy intake (kJ/day)‡¶ | 9828 (164)ABC | 10632 (275)C | 10685 (319)BC | 9542 (253)AB | 9124 (197)A | <0.001 |
| Sodium intake (mg/day)‡\*\* | 2842 (73)A | 2845 (171)AB | 2529 (67)B | 2596 (96)AB | 2443 (86)B | <0.001 |
| Potassium intake (mg/day)‡\*\* | 3060 (55)A | 3450 (134)AB | 3403 (86)B | 3490 (71)B | 3503 (71)B | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 34.0 (0.6)A | 31.9 (0.9)AB | 33.3 (1.2)A | 31.7 (0.7)AB | 29.0 (0.9)B | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.4 (0.4)A | 14.2 (0.6)A | 14.0 (0.6)A | 13.6 (0.5)A | 14.2 (0.5)A | 0.70 |
| Monounsaturated fat intake (g/day)‡\*\* | 34.6 (0.5)A | 32.9 (1.1)AB | 32.8 (0.9)AB | 31.4 (0.7)B | 30.5 (0.9)B | <0.001 |
| Trans fat intake (mg/day)‡\*\* | 1699 (51)A | 1591 (72)A | 1714 (82)A | 1618 (66)A | 1435 (93)A | 0.08 |
| Free sugar intake (% energy)‡¶ | 10.8 (0.3)A | 10.6 (0.6)AB | 10.2 (0.5)AB | 9.5 (0.5)AB | 9.1 (0.4)B | 0.01 |
| Alcohol intake (g/day)‡\*\* | 19.2 (1.4)A | 17.1 (2.7)AB | 12.7 (1.8)AB | 11.1 (1.4)B | 11.5 (1.4)B | <0.001 |
| University graduate (%)‖‖ | 31.0 (3.0)A | 31.8 (2.9)A | 30.8 (3.4)A | 31.9 (3.9)A | 36.3 (4.5)A | 0.81 |
| Current smoker (%)‖‖ | 16.6 (1.8)A | 7.9 (2.13)A | 10.6 (2.2)A | 10.4 (3.2)A | 8.8 (2.3)A | 0.02 |
| Physically active (%)‖‖ | 82.9 (1.7)A | 84.8 (2.5)A | 87.3 (2.2)A | 82.1 (3.2)A | 81.4 (3.2)A | 0.56 |
| Using lipid medication (%)‖‖ | 10.0 (1.1)A | 13.6 (2.3)ABC | 10.7 (2.0)AC | 20.2 (3.2)BC | 20.0 (3.4)B | <0.001 |
| **Approach 2b** | | | | | | |
| n | 5,118,484 | 1,421,110 | 1,429,688 | 1,412,414 | 1,420,924 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 22.9 | 41.0 | 62.1 | 104.7 |  |
| Age‡§ | 42.7 (0.7)A | 49.6 (1.6)B | 46.7 (1.9)AB | 50.8 (1.8)B | 49.3 (1.5)B | <0.001 |
| Female (%)‖‖ | 46.6 (2.1)A | 60.5 (3.6)B | 50.4 (3.7)ABC | 46.6 (3.4)AC | 47.8 (4.7)ABC | 0.07 |
| Energy intake (kJ/day)‡¶ | 9878 (159)ABC | 10844 (312)C | 10374 (259)BC | 9518 (257)AB | 9115 (208)A | <0.001 |
| Sodium intake (mg/day)‡\*\* | 2866 (74)B | 2693 (89)AB | 2554 (66)A | 2592 (102)AB | 2422 (91)A | <0.001 |
| Potassium intake (mg/day)‡\*\* | 3098 (64)A | 3432 (89)B | 3375 (93)AB | 3498 (67)B | 3515 (77)B | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 34.0 (0.6)B | 31.9 (0.9)AB | 32.9 (1.1)B | 31.8 (0.8)AB | 28.5 (0.8)A | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.5 (0.4)A | 13.8 (0.5)A | 13.9 (0.7)A | 14.0 (0.5)A | 14.1 (0.5)A | 0.83 |
| Monounsaturated fat intake (g/day)‡\*\* | 34.4 (0.5)A | 33.3 (0.85)AB | 32.5 (1.0)AB | 31.5 (0.7)B | 30.3 (0.9)B | <0.001 |
| Trans fat intake (mg/day)‡\*\* | 1725 (52)A | 1608 (82)A | 1663 (74)A | 1622 (72)A | 1340 (60) | <0.001 |
| Free sugar intake (% energy)‡¶ | 11.0 (0.3)A | 10.1 (0.7)AB | 10.0 (0.5)AB | 9.3 (0.5)AB | 9.1 (0.4)B | 0.006 |
| Alcohol intake (g/day)‡\*\* | 18.3 (1.3)A | 19.0 (2.8)AB | 11.5 (1.9)AB | 11.5 (1.4)B | 11.9 (1.5)B | 0.001 |
| University graduate (%)‖‖ | 31.2 (2.9)A | 29.3 (3.0)A | 32.3 (3.0)A | 30.7 (4.0)A | 38.3 (4.6)A | 0.50 |
| Current smoker (%)‖‖ | 17.2 (1.6)A | 6.7 (2.3)A | 9.8 (2.2)A | 9.0 (3.1)A | 8.3 (2.2)A | 0.002 |
| Physically active (%)‖‖ | 83.1 (1.5)A | 85.5 (2.6)A | 87.3 (2.4)A | 80.7 (3.9)A | 81.4 (2.9)A | 0.48 |
| Using lipid medication (%)‖‖ | 6.7 (1.1)A | 14.6 (2.4)AB | 11.7 (2.4)AB | 21.2 (3.3)B | 19.8 (3.5)B | <0.001 |

\* N (weighted) is based on participants 19 years and over within the NNPAS 2011-12 that have complete information for all characteristics of interest .

† Associations with continuous variables were determined through a test for equality of means post linear regression. Associations with categorical variables were determined through Pearson’s chi2 analysis. Presence of a significant difference is observed at p<0.05

‡ Reported as x̅ (SEM)

§ Linear regression adjusted for sex

‖‖ Reported as percentage (SE)

¶ Linear regression adjusted for age and sex

\*\* Linear regression adjusted for age, sex and energy intake (kJ/day)

Categories sharing capital letters within rows are not statistically significant from each other. Comparison of means were conducted through pairwise comparison. Comparison of percentages were conducted through individual Pearson’s chi2 analysis. All comparisons applied a Bonferroni correction for multiple comparisons such that a significant difference was observed at P<0.005. Some significance is lost between categories when applying Bonferroni correction.

**Supplemental Table 5.** Demographic characteristics by categories of whole-grain intake for Swedish adults (n=1,372 for all approaches)\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Whole-grain intake** | | | | | **p-value**† |
|  | **Non-consumers** | **Q1** | **Q2** | **Q3** | **Q4** |  |
| **Approach 1a** | | | | | | |
| n | 39 | 334 | 333 | 333 | 333 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 15.9 | 33.8 | 51.8 | 82.0 |  |
| Age‡§ | 39.8 (2.6)A | 43.9 (0.9)A | 47.1 (0.9)A | 51.5 (0.9)B | 53.6 (0.9)B | <0.001 |
| Female (%)‖‖ | 53.9 (8.0)AB | 54.2 (2.7)A | 58.6 (2.7)AB | 65.2 (2.6)B | 55.9 (2.7)AB | 0.04 |
| Energy intake (kJ/day)‡¶ | 8024 (265)A | 9001 (91)B | 8852 (90)B | 8886 (91)B | 8636 (91)AB | 0.001 |
| Saturated fat intake (g/day)‡\*\* | 38.0 (1.3) | 33.6 (0.4)A | 32.4 (0.4)A | 32.3 (0.4)A | 29.4 (0.4) | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.9 (0.8)A | 13.6 (0.3)A | 13.9 (0.3)A | 13.9 (0.3)A | 13.0 (0.3)A | 0.16 |
| Monounsaturated fat intake (g/day)‡\*\* | 35.9 (1.0)A | 32.9 (0.4)A | 31.4 (0.4)B | 31.4 (0.4)B | 28.6 (0.4) | <0.001 |
| Alcohol intake (g/day)‡\*\* | 9.5 (2.2)ABC | 12.4 (0.8)BC | 14.2 (0.8)C | 10.2 (0.8)AB | 7.6 (0.8)A | <0.001 |
| University graduate (%)‖‖ | 35.9 (7.7)AB | 38.6 (2.7)AC | 53.8 (2.7)B | 52.6 (2.7)B | 46.6 (2.7)AB | <0.001 |
| Current smoker (%)‖‖ | 30.8 (7.4)A | 23.1 (2.3)A | 12.9 (1.8)B | 11.4 (1.7)B | 9.3 (1.6)B | <0.001 |
| Physically active at work (%)‖‖ | 38.5 (7.8)A | 28.7 (2.5)A | 27.0 (2.4)A | 26.7 (2.4)A | 20.4 (2.2)A | 0.04 |
| Physically active for leisure (%)‖‖ | 35.9 (7.7)AC | 43.4 (2.7)AB | 51.7 (2.7)AC | 56.8 (2.7)C | 58.6 (2.7)C | <0.001 |
| **Approach 1b** | | | | | | |
| n | 156 | 304 | 304 | 304 | 304 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 9.8 | 19.8 | 30.2 | 50.6 |  |
| Age‡§ | 41.4 (1.3)A | 45.4 (0.9)AB | 48.1 (0.9)BC | 50.6 (0.9)C | 54.9 (0.9) | <0.001 |
| Female (%)‖‖ | 54.5 (4.0)A | 54.6 (2.9)A | 60.8 (2.8)A | 59.9 (2.8)A | 59.9 (2.8)A | 0.40 |
| Energy intake (kJ/day)‡¶ | 8430 (132)A | 9277 (94)B | 8956 (93)BC | 8715 (94)AC | 8534 (95)A | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 34.3 (0.6)A | 32.0 (0.5)BC | 32.5 (0.5)AB | 32.5 (0.5)AB | 30.4 (0.5)C | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.0 (0.4)A | 14.1 (0.3)A | 13.8 (0.3)A | 13.6 (0.3)A | 13.3 (0.3)A | 0.17 |
| Monounsaturated fat intake (g/day)‡\*\* | 33.4 (0.5)A | 31.6 (0.4)AB | 31.9 (0.4)AB | 30.9 (0.4)B | 29.4 (0.4) | <0.001 |
| Alcohol intake (g/day)‡\*\* | 11.1 (1.1)AB | 11.9 (0.8)AB | 12.4 (0.8)A | 11.4 (0.8)AB | 8.6 (0.8)B | 0.01 |
| University graduate (%)‖‖ | 42.3 (4.0)A | 46.7 (2.9)A | 49.0 (2.9)A | 48.7 (2.9)A | 48.4 (2.9)A | 0.68 |
| Current smoker (%)‖‖ | 25.0 (3.5)A | 16.5 (2.1)AB | 14.8 (2.0)AB | 10.5 (1.8)B | 11.5 (1.8)B | <0.001 |
| Physically active at work (%)‖‖ | 25.6 (3.5)AB | 32.9 (2.7)A | 25.3 (2.5)AB | 26.0 (2.5)AB | 20.4 (2.3)B | 0.01 |
| Physically active for leisure (%)‖‖ | 40.4 (3.9)A | 49.0 (2.9)AB | 55.6 (2.9)BC | 53.0 (2.9)AB | 56.9 (2.8)BC | 0.007 |
| **Approach 2a** | | | | | | |
| n | 93 | 320 | 320 | 320 | 319 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 18.0 | 32.7 | 49.9 | 80.1 |  |
| Age‡§ | 43.1 (1.7)A | 44.2 (0.9)A | 47.4 (0.9)A | 51.5 (0.9)B | 53.7 (0.9)B | <0.001 |
| Female (%)‖‖ | 51.6 (5.2)AB | 53.4 (2.8)A | 60.3 (2.7)AB | 64.4 (2.68)B | 57.1 (2.8)AB | 0.03 |
| Energy intake (kJ/day)‡¶ | 8383 (171)A | 9047 (93)B | 8832 (92)AB | 8889 (92)AB | 8641 (93)A | 0.002 |
| Saturated fat intake (g/day)‡\*\* | 35.4 (0.8)A | 33.4 (0.4)AB | 32.6 (0.4)B | 32.2 (0.4)B | 29.3 (0.4) | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.4 (0.5)A | 13.8 (0.3)A | 13.9 (0.3)A | 13.7 (0.3)A | 13.1 (0.3)A | 0.24 |
| Monounsaturated fat intake (g/day)‡\*\* | 34.1 (0.7)A | 32.8 (0.4)AB | 31.5 (0.4)BC | 31.3 (0.4)C | 28.5 (0.4) | <0.001 |
| Alcohol intake (g/day)‡\*\* | 11.2 (1.5)ABC | 12.6 (0.8)BC | 13.7 (0.8)C | 10.1 (0.8)AB | 7.8 (0.8)A | 0.03 |
| University graduate (%)‖‖ | 34.4 (4.9)AB | 41.9 (2.8)AC | 52.8 (2.8)C | 52.5 (2.8)C | 46.7 (2.8)AC | 0.002 |
| Current smoker (%)‖‖ | 26.9 (4.6)A | 20.6 (2.3)AC | 13.1 (1.9)BC | 11.9 (1.8)B | 9.4 (1.6)B | <0.001 |
| Physically active at work (%)‖‖ | 31.2 (4.8)A | 30.0 (2.6)A | 26.3 (2.5)A | 25.3 (2.4)A | 21.3 (2.3)A | 0.10 |
| Physically active for leisure (%)‖‖ | 36.6 (5.0)A | 45.9 (2.8)AB | 53.1 (2.8)BC | 55.6 (2.8)BC | 58.3 (2.8)C | <0.001 |
| **Approach 2b** | | | | | | |
| n | 194 | 295 | 294 | 295 | 294 |  |
| Median whole-grain intake (g/10MJ/day) | 0 | 11.4 | 20.5 | 30.8 | 51.5 |  |
| Age‡§ | 42.0 (1.2)A | 46.1 (0.9)AB | 48.0 (0.9)BC | 50.6 (0.9)C | 54.8 (0.9) | <0.001 |
| Female (%)‖‖ | 53.6 (3.6)A | 55.6 (2.9)A | 61.2 (2.8)A | 59.3 (2.9)A | 60.2 (2.9)A | 0.37 |
| Energy intake (kJ/day)‡¶ | 8535 (118)A | 9332 (95) | 8915 (95)A | 8679 (95)A | 8542 (96)A | <0.001 |
| Saturated fat intake (g/day)‡\*\* | 33.8 (0.6)A | 32.0 (0.5)AB | 32.8 (0.5)A | 32.3 (0.5)A | 30.3 (0.5)B | <0.001 |
| Polyunsaturated fat intake (g/day)‡\*\* | 13.1 (0.4)A | 14.2 (0.3)A | 13.6 (0.3)A | 13.6 (0.3)A | 13.3 (0.3)A | 0.11 |
| Monounsaturated fat intake (g/day)‡\*\* | 32.8 (0.5)A | 32.0 (0.4)AB | 31.7 (0.4)AB | 30.7 (0.4)BC | 29.3 (0.4)C | <0.001 |
| Alcohol intake (g/day)‡\*\* | 11.1 (1.0)AB | 12.0 (0.8)AB | 12.3 (0.8)A | 11.2 (0.8)AB | 8.7 (0.8)B | 0.06 |
| University graduate (%)‖‖ | 39.7 (3.5)A | 49.5 (2.9)A | 49.0 (2.9)A | 48.8 (2.9)A | 48.0 (2.9)A | 0.22 |
| Current smoker (%)‖‖ | 23.7 (3.1)A | 15.3 (2.1)AB | 15.0 (2.1)AB | 10.9 (1.8)B | 11.4 (1.9)B | 0.001 |
| Physically active at work (%)‖‖ | 28.4 (3.2)AB | 30.9 (2.7)A | 25.9 (2.6)AB | 26.1 (2.6)AB | 20.1 (2.3)B | 0.05 |
| Physically active for leisure (%)‖‖ | 39.2 (3.5)A | 51.2 (2.9)AB | 55.8 (2.9)BC | 53.9 (2.9)BC | 56.1 (2.9)BC | 0.002 |

\* N is based on participants within the Riksmaten adults 2010-11 that have complete information for all characteristics of interest. Participants identified as under- or over-reporters were excluded.

† Associations with continuous variables were determined through a test for equality of means post linear regression. Associations with categorical variables were determined through Pearson’s chi2 analysis. Presence of a significant difference is observed at p<0.05

‡ Reported as x̅ (SEM)

§ Linear regression adjusted for sex

‖‖ Reported as percentage (SE)

¶ Linear regression adjusted for age and sex

\*\* Linear regression adjusted for age, sex and energy intake (kJ/day)

Categories sharing capital letters within rows are not statistically significant from each other. Comparison of means were conducted through pairwise comparison. Comparison of percentages were conducted through individual Pearson’s chi2 analysis. All comparisons applied a Bonferroni correction for multiple comparisons such that a significant difference was observed at P<0.005. Some significance is lost between categories when applying a Bonferroni correction.

**Supplemental Table 6.** Whole grain intakes of Australian and Swedish adults across whole grain food definition approaches\*†

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Whole grain intake (g/day)**‡ | | | | | | | | | | | | | | | | |
| **n**§ | **Approach 1a** | | | | **Approach 1b** | | | | **Approach 2a** | | | | **Approach 2b** | | | |
| Mean | SE | Median | IQR | Mean | SE | Median | IQR | Mean | SE | Median | IQR | Mean | SE | Median | IQR |
| **Male** | | | | | | | | | | | | | | | | | |
| Australia‖‖ | 8,274,171 | 39.1 | 1.0 | 22.2 | 0.0-61.3 | 37.3 | 1.0 | 21.2 | 0.0-59.1 | 32.5 | 1.0 | 4.9 | 0.0-52.8 | 31.2 | 1.0 | 0.0 | 0.0-50.5 |
| *Energy adjusted* | *41.3* | 1.1 | *25.4* | *0.0-65.4* | *39.6* | 1.0 | *23.0* | *0.0-63.9* | *34.4* | 1.1 | *5.7* | *0.0-55.7* | *33.1* | 1.0 | *0.0* | *0.0-54.5* |
| Sweden¶ | 792 | 40.3 | 1.0 | 35.2 | 18.0-56.4 | 22.3 | 0.7 | 19.1 | 8.6-31.9 | 38.1 | 1.0 | 33.4 | 16.7-54.6 | 22.2 | 0.7 | 19.6 | 8.6-32.0 |
| *Energy adjusted* | *43.7* | 1.1 | *38.8* | *20.6-62.6* | *24.5* | 0.7 | *20.9* | *9.1-35.7* | *41.4* | 1.1 | *36.6* | *19.5-60.7* | *24.3* | 0.7 | *21.2* | *9.1-35.2* |
| **Female** | | | | | | | | | | | | | | | | | |
| Australia‖‖ | 8,482,191 | 29.2 | 0.6 | 19.8 | 0.0-45.4 | 28.0 | 0.6 | 17.8 | 0.0-43.6 | 23.6 | 0.7 | 6.9 | 0.0-38.5 | 22.7 | 0.7 | 0.0 | 0.0-37.3 |
| *Energy adjusted* | *41.1* | 0.9 | *27.0* | *0.0-65.7* | *39.5* | 0.9 | *25.0* | *0.0-64.0* | *33.2* | 0.9 | *8.9* | *0.0-55.1* | *32.0* | 0.9 | *0.0* | *0.0-53.0* |
| Sweden¶ | 1,005 | 34.2 | 0.7 | 29.9 | 17.9-46.2 | 19.0 | 0.5 | 16.9 | 8.5-26.1 | 32.5 | 0.7 | 28.5 | 17.4-44.9 | 18.9 | 0.5 | 17.0 | 8.5-26.1 |
| *Energy adjusted* | *46.2* | 0.9 | *42.2* | *25.5-62.0* | *25.8* | 0.6 | *22.3* | *11.4-36.9* | *44.0* | 0.9 | *40.1* | *23.8-60.6* | *25.8* | 0.6 | *22.7* | *11.4-36.8* |
| **All** | | | | | | | | | | | | | | | | | |
| Australia‖‖ | 16,756,362 | 34.1 | 0.6 | 21.2 | 0.0-52.9 | 32.6 | 0.6 | 19.8 | 0.0-50.9 | 28.0 | 0.6 | 6.4 | 0.0-45.1 | 26.9 | 0.6 | 0.0 | 0.0-43.5 |
| *Energy adjusted* | *41.2* | 0.7 | *26.1* | *0.0-65.5* | *39.6* | 0.7 | *24.0* | *0.0-63.88* | *33.8* | 0.7 | *7.7* | *0.0-55.4* | *32.5* | 0.7 | *0.0* | *0.0-53.9* |
| Sweden¶ | 1,797 | 36.9 | 0.6 | 32.2 | 17.9-50.6 | 20.5 | 0.4 | 17.8 | 8.5-28.7 | 35.0 | 0.6 | 30.3 | 17.0-48.4 | 20.4 | 0.4 | 17.8 | 8.5-28.8 |
| *Energy adjusted* | *45.1* | 0.7 | *40.8* | *23.2-62.2* | *25.2* | 0.5 | *21.7* | *10.4-36.3* | *42.9* | 0.7 | *38.8* | *21.5-60.7* | *25.2* | 0.5 | *22.2* | *10.4-36.3* |

\* Australian adults = 19 years and over; Swedish adults = 18-80 years

† Approach 1a, no whole grain food definition (including discretionary); Approach 1b, no whole grain food definition (excluding discretionary); Approach 2a, whole grain food definition (including discretionary); Approach 2b, whole grain food definition (excluding discretionary)

‡ Energy adjusted values reported as g/10MJ/day

§ n in Australian data derived using sampling and replicate weights within a complex survey design method

‖‖ Data based on 1 day of dietary intake from National Nutrition and Physical Activity Survey (NNPAS) 2011-12

¶ Data based on MSM adjusted values from up to 4 days of dietary intake from Riksmaten Adults

**Supplemental Table 7.** Whole grain intakes of Australian and Swedish adults across age subcategories and whole grain food definition approaches\*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Whole grain intake (g/day)**† | | | | | | | | | | | | | | | | | |
| **n**‡ | **Approach 1a** | | | | **Approach 1b** | | | | **Approach 2a** | | | | **Approach 2b** | | | | |
| Mean | SE | Median | IQR | Mean | SE | Median | IQR | Mean | SE | Median | IQR | Mean | | SE | Median | IQR |
| **Age subcategory 1** | | | | | | | | | | | | | | | | | | |
| Australia 19-30§ | 3,875,435 | 30.0 | 1.3 | 13.0 | 0.0-49.0 | 27.8 | 1.2 | 6.3 | 0.0-44.9 | 24.7 | 1.3 | 0.0 | 0.0-39.6 | 22.8 | 1.2 | | 0.0 | 0.0-38.5 |
| *Energy adjusted* | *33.1* | 1.3 | *14.9* | *0.0-54.6* | *30.8* | 1.3 | *8.4* | *0.0-52.3* | *27.0* | 1.3 | *0.0* | *0.0-46.3* | *25.1* | 1.2 | | *0.0* | *0.0-43.6* |
| Sweden 18-30‖‖ | 335 | 30.4 | 1.4 | 25.7 | 12.2-41.4 | 15.4 | 0.9 | 12.8 | 0.0-21.7 | 28.8 | 1.4 | 24.6 | 11.2-39.0 | 15.5 | 0.9 | | 12.9 | 0.0-21.9 |
| *Energy adjusted* | *36.8* | 1.6 | *32.5* | *14.9-52.8* | *18.0* | 1.0 | *14.8* | *0.0-26.9* | *35.0* | 1.5 | *30.4* | *13.2-50.7* | *18.2* | 1.0 | | *14.9* | *0.0-27.7* |
| **Age subcategory 2** | | | | | | | | | | | | | | | | | | |
| Australia 31-50§ | 6,261,381 | 32.9 | 0.9 | 18.2 | 0.0-49.6 | 31.2 | 0.9 | 15.4 | 0.0-47.6 | 27.1 | 1.0 | 0.0 | 0.0-42.4 | 25.9 | 0.9 | | 0.0 | 0.0-39.6 |
| *Energy adjusted* | *38.7* | 1.0 | *21.1* | *0.0-59.6* | *36.8* | 1.0 | *18.2* | *0.0-57.9* | *31.8* | 1.1 | *0.0* | *0.0-49.8* | *30.3* | 1.0 | | *0.0* | *0.0-47.7* |
| Sweden 31-60‖‖ | 962 | 36.3 | 0.8 | 31.0 | 17.5-49.4 | 19.9 | 0.5 | 17.3 | 8.5-27.0 | 34.4 | 0.8 | 29.2 | 16.5-47.4 | 19.8 | 0.5 | | 17.2 | 8.5-27.2 |
| *Energy adjusted* | *43.7* | 0.9 | *39.2* | *22.5-60.4* | *24.3* | 0.6 | *20.9* | *10.4-35.4* | *41.6* | 0.9 | *37.7* | *20.3-57.4* | *24.2* | 0.6 | | *21.4* | *10.3-35.1* |
| **Age subcategory 3** | | | | | | | | | | | | | | | | | | |
| Australia 51-70§ | 4,807,826 | 36.4 | 1.1 | 24.1 | 0.0-55.8 | 35.5 | 1.1 | 23.0 | 0.0-54.8 | 29.8 | 1.1 | 14.1 | 0.0-49.1 | 29.2 | 1.1 | | 11.8 | 0.0-47.6 |
| *Energy adjusted* | *45.7* | 1.4 | *32.8* | *0.0-71.6* | *44.6* | 1.4 | *31.1* | *0.0-70.6* | *37.3* | 1.3 | *18.0* | *0.0-60.1* | *36.6* | 1.3 | | *15.3* | *0.0-59.3* |
| Sweden 61-74‖‖ | 428 | 41.2 | 1.2 | 37.8 | 22.8-54.8 | 24.3 | 0.8 | 21.3 | 12.4-33.1 | 39.0 | 1.2 | 36.1 | 21.0-53.4 | 24.2 | 0.8 | | 21.5 | 12.7-33.2 |
| *Energy adjusted* | *52.2* | 1.4 | *49.9* | *31.1-69.6* | *31.2* | 1.0 | *27.7* | *15.6-43.6* | *49.5* | 1.4 | *46.5* | *27.9-66.7* | *31.1* | 1.0 | | *27.7* | *15.8-43.7* |
| **Age subcategory 4** | | | | | | | | | | | | | | | | | | |
| Australia >70§ | 1,811,721 | 40.4 | *1.4* | 33.7 | 10.0-58.9 | 39.7 | *1.4* | 33.4 | 7.5-58.2 | 33.4 | *1.3* | 23.3 | 0.0-53.8 | 33.0 | *1.4* | | 22.2 | 0.0-53.8 |
| *Energy adjusted* | *55.7* | *2.0* | *46.9* | *14.3-84.7* | *54.8* | *2.0* | *45.8* | *11.3-83.8* | *45.7* | *1.8* | *33.1* | *0.0-73.6* | *45.3* | *1.9* | | *32.0* | *0.0-73.6* |
| Sweden 75-80‖‖ | 72 | 49.1 | *3.3* | 45.8 | 29.6-65.1 | 28.8 | *2.3* | 24.6 | 15.3-39.4 | 46.9 | *3.3* | 42.4 | 27.8-62.6 | 28.6 | *2.3* | | 24.6 | 15.3-39.3 |
| *Energy adjusted* | *60.3* | *3.5* | *58.3* | *41.9-77.9* | *35.9* | *2.7* | *31.9* | *19.9-48.9* | *57.7* | *3.6* | *57.5* | *36.5-76.6* | *35.7* | *2.7* | | *30.7* | *19.7-48.9* |

\* Approach 1a, no whole grain food definition (including discretionary); Approach 1b, no whole grain food definition (excluding discretionary); Approach 2a, whole grain food definition (including discretionary); Approach 2b, whole grain food definition (excluding discretionary)

† Energy adjusted values reported as g/10MJ/day

‡ n in Australian data derived using sampling and replicate weights within a complex survey design method

§ Data based on 1 day of dietary intake from National Nutrition and Physical Activity Survey (NNPAS) 2011-12

‖‖ Data based on MSM adjusted values from up to 4 days of dietary intake from Riksmaten Adults

**Supplemental Table 8**. Proportion of participants with decreased energy-adjusted whole-grain intakes between whole-grain food definition approaches in Australia and Sweden

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Change in energy-adjusted whole-grain intake (g/10MJ/day)\*† | | | | | | | | | | | | | | |
| **Comparison 1**  **Approach 1a vs approach 1b** | | | | | **Comparison 2**  **Approach 1a vs approach 2a** | | | | | **Comparison 3**  **Approach 1a vs approach 2b** | | | | |
|  | Proportion decrease (%) | | | |  | Proportion decrease (%) | | | |  | Proportion decrease (%) | | | |
|  | **n‡** | Proportion any decrease (%) | <25% | 25-50% | 50-75% | 75-100% | Proportion any decrease (%) | <25% | 25-50% | 50-75% | 75-100% | Proportion any decrease (%) | <25% | 25-50% | 50-75% | 75-100% |
| **Male** | | | | | | | | | | | | | | | | |
| Australia§ | 4,282 | 10.0 | 4.3 | 1.3 | 0.7 | 3.7 | 37.9 | 11.3 | 5.6 | 1.8 | 19.2 | 41.2 | 11.6 | 5.8 | 1.8 | 22.0 |
| Sweden‖‖ | 792 | 87.0 | 25.8 | 23.2 | 20.6 | 17.4 | 74.6 | 64.0 | 4.4 | 1.1 | 5.1 | 88.1 | 25.5 | 24.2 | 19.1 | 19.3 |
| **Female** | | | | | | | | | | | | | | | | |
| Australia§ | 5,059 | 10.1 | 4.6 | 1.6 | 0.6 | 3.4 | 41.1 | 11.8 | 5.9 | 2.7 | 20.8 | 44.1 | 11.6 | 6.5 | 2.8 | 23.2 |
| Sweden‖‖ | 1,005 | 89.9 | 26.2 | 25.3 | 22.4 | 16.0 | 70.6 | 61.8 | 4.2 | 0.7 | 4.0 | 89.7 | 25.2 | 25.5 | 21.9 | 17.1 |
| **All** | | | | | | | | | | | | | | | | |
| Australia§ | 9,341 | 10.1 | 4.5 | 1.5 | 0.6 | 3.8 | 39.6 | 11.5 | 5.8 | 2.3 | 20.0 | 42.8 | 11.6 | 6.2 | 2.3 | 22.6 |
| Sweden‖‖ | 1,797 | 88.6 | 26.0 | 24.4 | 21.6 | 16.6 | 72.4 | 62.8 | 4.3 | 0.9 | 4.5 | 90.0 | 25.3 | 24.9 | 20.6 | 18.1 |

\* Approach 1a, no whole-grain food definition (including discretionary); Approach 1b, no whole-grain food definition (excluding discretionary); Approach 2a, whole-grain food definition (including discretionary); Approach 2b, whole-grain food definition (excluding discretionary)

† Proportion any increase in Swedish data (%): Comparison 1: M 8.1, F 6.7, All 7.3; Comparison 2: M 20.5, F 25.9, All 23.5; Comparison 3: M 6.9, F 6.9, All 6.9. No increases in Australian data

‡ Derived using unweighted data

§ Data based on 1 day of dietary intake from National Nutrition and Physical Activity Survey (NNPAS) 2011-12

‖‖ Data based on MSM adjusted values from up to 4 days of dietary intake from Riksmaten Adults

**Supplemental Table 9.** Association between grams of energy-adjusted whole-grain intake and cardiovascular disease risk factor measures for different whole-grain food definition approaches in Australian adults

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Coefficient** | **SE** | **p-value**\* | **95% CI** |
| **Total cholesterol (mmol/L)**†\*\*  (n=10,755,617) [unweighted n=2,397] | | | | |
| Approach 1a | 0.016 | 0.0002 | 0.32 | -0.016 to 0.049 |
| Approach 1b | 0.020 | 0.0002 | 0.23 | -0.013 to 0.053 |
| Approach 2a | 0.025 | 0.0002 | 0.13 | -0.008 to 0.058 |
| Approach 2b | 0.029 | 0.0002 | 0.09 | -0.004 to 0.062 |
| **Fasting LDL-cholesterol (mmol/L)**†\*\*  (n=10,659,100) [unweighted n=2,373] | | | | |
| Approach 1a | 0.021 | 0.0002 | 0.34 | -0.022 to 0.064 |
| Approach 1b | 0.027 | 0.0002 | 0.21 | -0.016 to 0.079 |
| Approach 2a | 0.036 | 0.0002 | 0.10 | -0.007 to 0.079 |
| Approach 2b | 0.043 | 0.0002 | 0.05 | -0.001 to 0.086 |
| **HDL-cholesterol (mmol/L)**†\*\*  (n=10,755,617) [unweighted n=2,397] | | | | |
| Approach 1a | 0.008 | 0.0002 | 0.66 | -0.028 to 0.044 |
| Approach 1b | 0.008 | 0.0002 | 0.69 | -0.030 to 0.046 |
| Approach 2a | 0.009 | 0.0002 | 0.65 | -0.029 to 0.046 |
| Approach 2b | 0.007 | 0.0002 | 0.72 | -0.032 to 0.046 |
| **Fasting triglycerides (mmol/L)**‡\*\*  (n=10,755,617) [unweighted n=2,397] | | | | |
| Approach 1a | 0.006 | 0.0004 | 0.88 | -0.074 to 0.086 |
| Approach 1b | 0.003 | 0.0004 | 0.93 | -0.075 to 0.082 |
| Approach 2a | 0.004 | 0.0004 | 0.92 | -0.076 to 0.085 |
| Approach 2b | 0.004 | 0.0004 | 0.93 | -0.077 to 0.084 |
| **Fasting blood glucose (mmol/L)**§\*\*  (n=10,919,655) [unweighted n=2,427] | | | | |
| Approach 1a | -0.014 | 0.0001 | 0.06 | -0.0284 to 0.0004 |
| Approach 1b | -0.015 | 0.0001 | 0.04 | -0.0294 to -0.0007 |
| Approach 2a | -0.013 | 0.0001 | 0.09 | -0.0272 to 0.0020 |
| Approach 2b | -0.014 | 0.0001 | 0.06 | -0.0289 to 0.0004 |
| **HbA1c (%)**§\*\*  (n=12,858,984) [unweighted n=2,842] | | | | |
| Approach 1a | -0.004 | 0.0001 | 0.49 | -0.015 to 0.007 |
| Approach 1b | -0.003 | 0.0001 | 0.55 | -0.014 to 0.008 |
| Approach 2a | -0.004 | 0.0001 | 0.46 | -0.014 to 0.006 |
| Approach 2b | -0.004 | 0.0001 | 0.47 | -0.014 to 0.007 |
| **Apolipoprotein B (g/L)**†  (n=10,755,617) [unweighted n=2,397] | | | | |
| Approach 1a | 0.0001 | 0.0002 | 0.73 | -0.0003 to 0.0005 |
| Approach 1b | 0.0001 | 0.0002 | 0.52 | -0.0003to 0.0005 |
| Approach 2a | 0.0002 | 0.0002 | 0.37 | -0.0002 to 0.0006 |
| Approach 2b | 0.0003 | 0.0002 | 0.22 | -0.0002 to 0.0007 |
| **C-reactive protein (CRP) (mg/L)**†  (n=10,755,617) [unweighted n=2,397] | | | | |
| Approach 1a | -0.004 | 0.0050 | 0.41 | -0.014 to 0.006 |
| Approach 1b | -0.004 | 0.0051 | 0.50 | -0.014 to 0.007 |
| Approach 2a | -0.005 | 0.0044 | 0.23 | -0.014 to 0.004 |
| Approach 2b | -0.005 | 0.0046 | 0.30 | -0.014 to 0.004 |
| **BMI (kg/m2)**‖‖  (n=10,961,693) [unweighted n=5,983] | | | | |
| Approach 1a | -0.007 | 0.0017 | <0.001 | -0.011 to -0.004 |
| Approach 1b | -0.008 | 0.0017 | <0.001 | -0.011 to -0.004 |
| Approach 2a | -0.008 | 0.0016 | <0.001 | -0.011 to -0.004 |
| Approach 2b | -0.008 | 0.0016 | <0.001 | -0.011 to -0.005 |
| **Body weight (kg)**‖‖  (n=11,016,618) [unweighted n=6,016] | | | | |
| Approach 1a | -0.018 | 0.0055 | 0.002 | -0.029 to -0.007 |
| Approach 1b | -0.019 | 0.0057 | 0.002 | -0.030 to -0.007 |
| Approach 2a | -0.021 | 0.0054 | <0.001 | -0.032 to -0.010 |
| Approach 2b | -0.022 | 0.0055 | <0.001 | -0.033 to -0.011 |
| **Waist circumference (cm)**‖‖  (n=10,776,386) [unweighted n=5,914] | | | | |
| Approach 1a | -0.019 | 0.0047 | <0.001 | -0.029 to -0.010 |
| Approach 1b | -0.020 | 0.0047 | <0.001 | -0.029 to -0.010 |
| Approach 2a | -0.021 | 0.0044 | <0.001 | -0.030 to -0.012 |
| Approach 2b | -0.021 | 0.0043 | <0.001 | -0.030 to -0.012 |
| **Waist-to-height ratio**‖‖  (n=10,742,269) [unweighted n=5,888] | | | | |
| Approach 1a | -0.0001 | 0.0000 | <0.001 | -0.0002 to -0.0001 |
| Approach 1b | -0.0001 | 0.0000 | <0.001 | -0.0002 to -0.0001 |
| Approach 2a | -0.0001 | 0.0000 | <0.001 | -0.0002 to -0.0001 |
| Approach 2b | -0.0001 | 0.0000 | <0.001 | -0.0002 to -0.0001 |
| **Systolic blood pressure (mmHg)**¶  (n=10,611,432) [unweighted n=5,800] | | | | |
| Approach 1a | 0.003 | 0.0069 | 0.69 | -0.011 to 0.017 |
| Approach 1b | 0.005 | 0.0069 | 0.49 | -0.009 to 0.019 |
| Approach 2a | 0.001 | 0.0069 | 0.86 | -0.013 to 0.015 |
| Approach 2b | 0.003 | 0.0068 | 0.69 | -0.011 to 0.016 |
| **Diastolic blood pressure (mmHg)**¶  (n=10,611,432) [unweighted n=5,800] | | | | |
| Approach 1a | -0.004 | 0.0038 | 0.27 | -0.012 to 0.003 |
| Approach 1b | -0.002 | 0.0038 | 0.53 | -0.010 to 0.005 |
| Approach 2a | -0.005 | 0.0041 | 0.25 | -0.013 to 0.003 |
| Approach 2b | -0.003 | 0.0041 | 0.44 | -0.011 to 0.005 |

\* Significance is determined at p<0.05

† Survey linear regression adjusted for age, sex, energy intake, education level, physical activity, current smoking status, intake of saturated, trans, monounsaturated and polyunsaturated fat, alcohol, lipid lowering medications, and BMI

‡ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity, current smoking status, intake of saturated, trans, monounsaturated and polyunsaturated fat, alcohol, free sugars, lipid lowering medications, and BMI

§ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity, current smoking status, intake of free sugars, and BMI

‖‖ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity, current smoking status

¶ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity, current smoking status, intake of sodium, potassium, and BMI

\*\* Coefficient, SE and 95% CI expressed as percentage increase/decrease (back transformed from natural log)

**Supplemental Table 10.** Association between categories of energy-adjusted whole-grain intake and cardiovascular disease risk factor measures for different whole-grain food definition approaches in Swedish adults

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Whole-grain intake**\*† | | | | | | | | | | **p-value for linear trend**‡ | **p-value**  **for significant difference**§ |
|  | **Non-consumers** | | **Q1** | | **Q2** | | **Q3** | | **Q4** | |  |  |
| **BMI (kg/m2)**‖‖  (n=1,365) | | | | | | | | | | | | |
| Approach 1a | 25.19A | 0.62 | 25.32A | 0.21 | 25.08A | 0.21 | 24.73A | 0.21 | 24.55A | 0.21 | 0.17 | 0.10 |
| Approach 1b | 25.13A | 0.31 | 24.81A | 0.22 | 25.23A | 0.22 | 24.93A | 0.22 | 24.63A | 0.22 | 0.29 | 0.34 |
| Approach 2a | 25.14A | 0.40 | 25.24A | 0.21 | 25.09A | 0.21 | 24.78A | 0.21 | 24.53A | 0,21 | 0.09 | 0.16 |
| Approach 2b | 25.07A | 0.28 | 24.80A | 0.22 | 25.16A | 0.22 | 25.05A | 0.22 | 24.61A | 0.22 | 0.41 | 0.39 |
| **Body weight (kg)**‖‖  (n=1,371) | | | | | | | | | | | | |
| Approach 1a | 71.75A | 1.96 | 75.18A | 0.68 | 73.95A | 0.66 | 73.49A | 0.67 | 72.87A | 0.67 | 0.90 | 0.12 |
| Approach 1b | 73.32A | 0.99 | 73.71A | 0.70 | 74.79A | 0.69 | 74.02A | 0.70 | 72.99A | 0.71 | 0.90 | 0.44 |
| Approach 2a | 73.47A | 1.28 | 75.12A | 0.69 | 74.04A | 0.68 | 73.29A | 0.68 | 72.90A | 0.69 | 0.34 | 0.20 |
| Approach 2b | 73.33A | 0.89 | 73.52A | 0.71 | 74.82A | 0.70 | 74.28A | 0.71 | 72.95A | 0.72 | 0.99 | 0.35 |
| **Waist circumference (cm)**‖‖  (n=1,310) | | | | | | | | | | | | |
| Approach 1a | 89.19A | 1.87 | 90.74A | 0.62 | 90.12A | 0.60 | 89.38A | 0.61 | 88.31A | 0.61 | 0.45 | 0.08 |
| Approach 1b | 89.85A | 0.91 | 89.77A | 0.64 | 90.44A | 0.63 | 89.94A | 0.63 | 88.23A | 0.64 | 0.21 | 0.15 |
| Approach 2a | 89.10AB | 1.17 | 91.04A | 0.62 | 90.04AB | 0.62 | 89.37AB | 0.62 | 88.20B | 0.62 | 0.22 | 0.03 |
| Approach 2b | 89.11A | 0.81 | 90.12A | 0.65 | 90.54A | 0.64 | 89.88A | 0.64 | 88.28A | 0.65 | 0.42 | 0.12 |
| **Waist-to-height ratio**‖‖  (n=1,306) | | | | | | | | | | | | |
| Approach 1a | 0.52A | 0.01 | 0.53A | 0.00 | 0.53A | 0.00 | 0.52A | 0.00 | 0.51A | 0.00 | 0.22 | 0.05 |
| Approach 1b | 0.53A | 0.01 | 0.52A | 0.00 | 0.53A | 0.00 | 0.52A | 0.00 | 0.51A | 0.00 | 0.11 | 0.14 |
| Approach 2a | 0.52AB | 0.01 | 0.53A | 0.00 | 0.53AB | 0.00 | 0.52AB | 0.00 | 0.51B | 0.00 | 0.19 | 0.02 |
| Approach 2b | 0.52A | 0.00 | 0.52A | 0.00 | 0.53A | 0.00 | 0.52A | 0.00 | 0.51A | 0.00 | 0.27 | 0.17 |
| **Waist-to-hip ratio**‖‖  (n=1,301) | | | | | | | | | | | | |
| Approach 1a | 0.90A | 0.01 | 0.89A | 0.00 | 0.89A | 0.00 | 0.90A | 0.00 | 0.89A | 0.00 | 0.68 | 0.69 |
| Approach 1b | 0.90A | 0.01 | 0.89A | 0.01 | 0.89A | 0.00 | 0.90A | 0.00 | 0.89A | 0.01 | 0.30 | 0.53 |
| Approach 2a | 0.90A | 0.01 | 0.89A | 0.00 | 0.89A | 0.00 | 0.90A | 0.00 | 0.89A | 0.00 | 0.66 | 0.65 |
| Approach 2b | 0.89A | 0.01 | 0.90A | 0.01 | 0.89A | 0.01 | 0.90A | 0.01 | 0.89A | 0.01 | 0.75 | 0.86 |
| **C-reactive protein (CRP) (mg/L)**¶  (n=3,528,709) [unweighted=231] | | | | | | | | | | | | |
| Approach 1a | 0.52AB | 0.57 | 1.29A | 0.12 | 0.68B | 0.12 | 1.01AB | 0.13 | 1.19AB | 0.18 | 0.24 | 0.004 |
| Approach 1b | 0.85AB | 0.22 | 1.01AB | 0.13 | 1.03AB | 0.13 | 0.76A | 0.10 | 1.39B | 0.20 | 0.28 | 0.06 |
| Approach 2a | 0.54AB | 0.18 | 1.30A | 0.16 | 0.70B | 0.09 | 1.03AB | 0.14 | 1.21AB | 0.18 | 0.08 | 0.004 |
| Approach 2b | 0.75A | 0.15 | 1.15A | 0.15 | 0.91A | 0.12 | 0.89A | 0.12 | 1.28A | 0.18 | 0.13 | 0.14 |

\* Values are reported as x̅ | SEM

† Means sharing capital letters within rows are not statistically significant from each other. Significance is determined at P<0.005 (Pairwise comparison with Bonferroni correction for multiple comparisons)

‡ P-value for linear trend. A significance is determined at p<0.05

§ P-value for significant difference determined through test for equality of means. Significance is determined at p<0.05

‖‖ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity at work, physical activity for leisure and current smoking status

¶ Survey linear regression adjusted for age, sex, energy intake, education level, physical activity at work, physical activity for leisure, current smoking status, intake of saturated fat, monounsaturated fat, polyunsaturated fat, alcohol, and BMI

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