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Consumption of predefined ‘Nordic’ dietary items in ten European countries – an investigation in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort

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Abstract

Objective: Health-beneficial effects of adhering to a healthy Nordic diet index have been suggested. However, it has not been examined to what extent the included dietary components are exclusively related to the Nordic countries or if they are part of other European diets as well, suggesting a broader preventive potential. The present study describes the intake of seven a priori defined healthy food items (apples/pears, berries, cabbages, dark bread, shellfish, fish and root vegetables) across ten countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) and examines their consumption across Europe.

Design: Cross-sectional study. A 24 h dietary recall was administered through a software program containing country-specific recipes. Sex-specific mean food intake was calculated for each centre/country, as well as percentage of overall food groups consumed as healthy Nordic food items. All analyses were weighted by day and season of data collection.

Setting: Multi-centre, European study.

Subjects: Persons (n 36 970) aged 35–74 years, constituting a random sample of 519 978 EPIC participants.

Results: The highest intakes of the included diet components were: cabbages and berries in Central Europe; apples/pears in Southern Europe; dark bread in Norway, Denmark and Greece; fish in Southern and Northern countries; shellfish in Spain; and root vegetables in Northern and Central Europe. Large inter-centre variation, however, existed in some countries.

Conclusions: Dark bread, root vegetables and fish are strongly related to a Nordic dietary tradition. Apples/pears, berries, cabbages, fish, shellfish and root vegetables are broadly consumed in Europe, and may thus be included in regional public health campaigns.
Dietary items defining a Nordic diet

other European countries as well. The items included in
the current paper are: apples/pears, berries, cabbages,
dark bread, shellfish, fish and root vegetables. Information
regarding consumption of these foods has been obtained
through 24 h diet recall (24HDR).

Methods and material

Study participants

EPIC is a multi-centre cohort study, initiated with the
purpose of investigating the relationship between nutri-
tion and incidence of cancer and other chronic diseases.
The cohort consists of participants from ten European
countries (Denmark, France, Germany, Great Britain,
Greece, Italy, the Netherlands, Norway, Spain and Sweden).
The population and inclusion of participants has been
described elsewhere(10). In brief, the cohorts consist of
519 978 men and women, recruited from 1992 to 2000.
Most are recruited from the general population(10), but in
France, Norway, Utrecht (the Netherlands) and Naples
(Italy), only women were included. In Spain and some
Italian centres, a large proportion of the participants
were blood donors, and in Oxford (Great Britain), some
of the participants were recruited from a selected, health-
conscious population consisting of vegetarians, vegans,
etc. All participants gave written informed consent, and
the study was approved by the local ethical committees of
the participating countries.

The present study is based on a subgroup of the
cohort, consisting of persons aged 35–74 years, who
Detailed information regarding selection and character-
istics of participants can be found elsewhere(11). Briefly,
this population consists of a random sample from each
country, representing 5–12% of local cohort participants
(1–5% in Great Britain), weighted according to the
cumulative number of cancer cases expected over
10 years of follow-up per gender and age stratum. The
sampling procedure aimed at an equal distribution of
season and day of interview to control for day-to-day
and seasonal variation in dietary intake. In some centres
(Ile-de-France, France; Potsdam, Germany; all centres in
the Netherlands and Denmark, and to some extent in the
remaining French centres; Heidelberg, Germany; and
Ragusa, Italy), participants in the 24HDR were recruited
without prior knowledge when participating in the
baseline examination, in order to avoid changes in dietary
habits. This was not possible in all centres, and in the
remaining centres, participants were invited to take
part in a 24HDR before study inclusion or were re-
contacted. Here, the 24HDR were conducted using a
face-to-face interview or via telephone (Norway only),
but participants were not informed beforehand about
the period of interest, in order to avoid changes in
dietary habits(11).

For the present study, individuals with missing infor-
mation on gender were excluded (n 24). This resulted in
a total study population of 36 970 individuals.

Dietary data

Each participant completed a single 24HDR. Information
regarding dietary intake of the included components
was collected using a computerized software program:
EPIC-SOFT, the details of which can be found else-
where(12,13). This software consisted of the same structure
and translated interface across countries, in order to
assess dietary intakes in a standardized manner. The
program was adapted for each country in terms of foods
and recipes included. Depending on the country, 150–200
food items and 150–300 recipes were entered. A total of
ninety trained interviewers in the ten countries assisted
the participants in completing the interview.

Information regarding all food and beverage items
consumed during the recalled day was collected, entered
and coded. During the interview, each reported food item
was described and quantified. Methods of quantifying
portion sizes were standardized between countries using
photographs of weight and volume, standard units,
household measures or exact amounts. Those participat-
ing via telephone interview were mailed these pictures
beforehand. For each food item, the final amount was
calculated taking into account quantification, cooking
method and edible part in order to obtain the total mass
consumed. The purpose of the 24HDR was to acquire
good estimates of mean food intake at population level,
and therefore mean intake of each food item is the
primary measurement of interest in the present study.

Foods were classified according to seventeen main
groups and 124 subgroups. Here, seven subgroups are
considered: cabbages, apples/pears (not including juices),
berries (not including jams and marmalades), dark bread,
fish, shellfish and root vegetables. The main food items
contributing to each subgroup, presented by country, are
shown in the online supplementary material (Supple-
mentary table S2).

Statistical methods

Analyses were conducted separately for men and women.
The statistical software package SAS version 9.1 for
Windows or TextPad was used for all analyses. The study
included calculations of mean food intake for each EPIC
centre and country, as well as for the total study population
(termed EPIC mean) for comparative purposes. Further-
more, we computed the percentage of overall food groups
(vegetables, fruit, bread, meat) which was constituted by
the included dietary items. For fish and shellfish, this was
calculated as a percentage of total meat intake defined as
meats, fish and shellfish. All analyses were weighted by day
and season of data collection to correct for discrepancies in
these between centres. Weighting by age did not materially
alter the results and was therefore not included.
A graphical representation of the mean intake of each food item in each centre along a north–south gradient is used to illustrate differences and similarities in food patterns across countries and by gender. For each food item, mean intake is compared with the EPIC-wide mean intake of the food item. Furthermore, spider plots are used to illustrate the consumption variability of each dietary component across participating countries.

We defined the following regions prior to analyses: (i) Northern European countries as Norway, Sweden and Denmark; (ii) Central European countries as Great Britain, the Netherlands, Germany and France; and (iii) Southern European countries as Greece, Italy and Spain.

Results

A total of 36 970 participants (64% women) from the EPIC cohort were included in the present study, representing all ten EPIC countries. The distribution of study participants was fairly even between Northern, Central and Southern European countries (Table 1).

Quantity of intake is explored in Fig. 1, where mean intake of each food item by country and gender is shown compared with the gender-specific EPIC mean. The percentage of each main food group consumed as one of the seven included healthy Nordic food items is presented in spider plots by gender (Fig. 2). Finally, the proportions of participants consuming at or above EPIC means of the seven included healthy Nordic food items is presented in spider plots by gender (Fig. 2).

Apples/pears

Apples and pears are consumed frequently in all participating countries; however, mean intake differs considerably, ranging from 47.5 g/d in Swedish men to 156.1 g/d in Italian men (Fig. 1(a)). A markedly higher consumption is found in Spain and Italy, compared with the other countries, especially driven by a high intake among men. The EPIC mean is 87.3 g/d for men and 80.8 g/d for women. With regard to percentage of total fruit intake, in both genders, this is one of the most stable food components across countries and centres (range: 23.0–31.1% in women, 22.4–36.5% in men), with no clear geographic gradient (Fig. 2).

Berries

The intake of berries varies considerably between countries, although not with a clear geographic gradient: mean intake is highest in Central Europe; among French, Germans and British participants (especially the health conscious) as well as Dutch women. Mean intake is lowest in Denmark and Greece (Fig. 1(b)). There is a large between-centre variation in Italy and Spain (see online supplementary material, Supplementary table s1). Women have a higher intake in all countries, except Denmark and Greece. The EPIC mean is 5.1 g/d for men and 8.5 g/d for women. When considering the percentage that berries contributes to total fruit intake, this is also highest for Central Europe: Germany, France (information available for women only), Great Britain and among Dutch women, but it is also high in Norway and Sweden (Fig. 2).

Cabbages

Cabbages are one of the food items that are consumed uniformly across the participating countries when considering mean intake (Fig. 1(c)). There is a tendency, though, of a higher intake in Central Europe: Germany, the Netherlands and Great Britain (especially in the health-conscious population), as well as among Norwegian women. Intake ranges from a mean of 10.3 g/d in Spanish men to 30.2 g/d in British women, compared with an EPIC mean of 17.2 g/d for men and 18.1 g/d for women. The percentage of total vegetable intake

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Number and proportion (%) of participants from each country in the present study on consumption of predefined ‘Nordic’ food items; men and women aged 35–74 years, constituting a random sample of the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Norway</td>
<td>N/A</td>
</tr>
<tr>
<td>Sweden</td>
<td>2797</td>
</tr>
<tr>
<td>Denmark</td>
<td>1923</td>
</tr>
<tr>
<td>Great Britain</td>
<td>528</td>
</tr>
<tr>
<td>Cambridge</td>
<td>263</td>
</tr>
<tr>
<td>Oxford, general population</td>
<td>151</td>
</tr>
<tr>
<td>Oxford, health conscious</td>
<td>114</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1270</td>
</tr>
<tr>
<td>Germany</td>
<td>2268</td>
</tr>
<tr>
<td>France</td>
<td>N/A</td>
</tr>
<tr>
<td>Greece</td>
<td>1469</td>
</tr>
<tr>
<td>Italy</td>
<td>1444</td>
</tr>
<tr>
<td>Spain</td>
<td>1777</td>
</tr>
<tr>
<td>All countries</td>
<td>13 476</td>
</tr>
</tbody>
</table>
consumed as cabbages is also highest in Central Europe and lowest in Southern Europe. However, there is quite a large between-centre variation in Southern Europe (see online supplementary material, Supplementary table s1). There is no clear tendency towards a uniformly higher consumption among one gender over the other.

**Root vegetables**

Root vegetables show a geographic gradient, with a very low intake in Southern Europe and a high intake in Northern and Central Europe, except in the Netherlands (Fig. 1(d)). The EPIC mean intake is 14-8 g/d for men and 19-9 g/d for women. The contribution of root vegetables to total vegetable consumption resembles the mean intake, with the lowest percentage found in Southern Europe (3-6% in Greek men, 4-5% in Greek women) and the highest in Northern Europe, ranging from 12-1% in Danish men to 19-9% in Norwegian women. For all countries with data available for both genders, except the British, women consume a larger percentage of their total vegetables as root vegetables than men (Fig. 2).

**Shellfish**

Mean intake of shellfish is especially high in Spain, but also in France, Greece and Italy (primarily for men), albeit with some centre variation (see online supplementary material, Supplementary table s1). There is, however, no clear geographic trend in shellfish intake, with the lowest intakes found in the Netherlands, Germany and Great Britain, and an intermediate consumption in the Nordic countries (Fig. 1(e)). The EPIC mean intake is 4-4 g/d for men and 3-9 g/d for women. Shellfish constitutes a very small percentage of the total meat intake in Great Britain, the Netherlands and Germany, and the highest percentage in Greece and Spain. For all countries with data available for both genders, shellfish constitutes a larger percentage of the total meat intake for women than for men (Fig. 2).
Fish

Although fish is consumed in all countries, there is quite a large variation in mean intakes, with an exceptionally high intake in Spain, intakes closer to the EPIC mean (37.9 g/d in men, 27.9 g/d in women) in most other countries, and the lowest intake in Germany and the Netherlands (Fig. 1(f)). With regard to fish as a percentage of total meats consumed, the pattern is very similar, with the highest percentage in Spain (27.5% in men, 28.7% in women), a fairly similar percentage in the Northern European countries and Great Britain, France and Greece, and a very low percentage in Germany and the Netherlands.

Dark bread

The intake of dark bread varies substantially, with a more than tenfold variation in mean intake across countries: it is very low in Spain and Italy and highest in Denmark, Norway, Greece, the Netherlands and Germany (Fig. 1(g)). In contrast to berries, men tend to have a higher intake in almost all centres. The EPIC mean intake is 83.6 g/d for men and 60.7 g/d for women. Dark bread constitutes a very high percentage of total bread consumption in Greece (85.2% in men, 81.8% in women) as well as the Northern countries (range: 56.5–71.0% in men, 60.7–82.8% in women), the Netherlands (65.1% in men, 74.3% in women) and Germany (65.8% in men, 69.8% in women).

Overall pattern

A summary of the proportions of participants consuming at or above gender-specific EPIC means for all seven included dietary items is shown in Table 2, by country. The score has a possible range from 0 to 7, with no participants scoring 7 points. Table 2 shows no clear geographic gradient across countries, but a tendency towards a higher proportion of participants scoring high on several items in Denmark, Norway (data for women only) and also among English women, and a lower proportion of participants scoring 0 points in Norway and Denmark and among the Oxford health-conscious population, but a higher proportion of participants scoring 0 points in Italy and Sweden.

Discussion

The purpose of the present study was to investigate the penetration of seven a priori defined healthy Nordic dietary items (apples/pears, berries, cabbages, dark bread, fish, shellfish and root vegetables) in the diet of ten European countries, in order to investigate if these were specifically related to a Nordic diet culture.

In our large study in ten European countries, we found a wide variation in intake of the included food items. However, for most food items, this variation did not follow a clear geographic gradient: intake of cabbages and berries was highest in Central Europe; intake of apples/pears was highest in Southern Europe; intake of dark bread was highest in Norway, Denmark and Greece; fish intake was highest in Southern as well as Northern countries; intake of shellfish was highest in Spain; and root vegetable intake was highest in Northern and Central European countries.
Thus the study results show that the included food items are not all typical for the Nordic countries, calling into question whether they should be considered specific Nordic dietary items. The dietary items most strongly related to the Nordic countries were dark bread, root vegetables and fish. However, none of these was exclusive to the Northern European countries, with a high consumption of dark bread also seen in Greece, of root vegetables also in Central Europe and of fish also in Southern Europe. For both fish and shellfish, there was a pattern with very low intakes in Germany and the Netherlands, which might be explained by the fact that these are the participating countries with the shortest coastlines and therefore they traditionally have low fish consumption.

In contrast to what could be expected, given the high profile of dark bread in Nordic gastronomy, the intake of dark bread was not highest here, but instead among Greek men, and it was also very high in Germany and the Netherlands. However, this may be due to a different type of ‘dark bread’ consumed across Europe: in the Nordic countries, this primarily refers to rye and coarse wholegrain bread, whereas elsewhere it primarily refers to bread with less wholegrain content. For instance, in the case of Greece, it primarily refers to consumption of ‘bread, wheat, brown’ (see online supplementary material, Supplementary table s2). Furthermore, the water content in dark bread may vary significantly across countries, which could explain some of the differences seen in intake between countries. As the 24HDR does not

### Table 2: Number and proportion of participants (n%) consuming at or above the EPIC mean for the seven predefined ‘Nordic’ food items, by gender and country; men and women aged 35–74 years, constituting a random sample of the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort

<table>
<thead>
<tr>
<th>Country</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of dietary items</td>
<td>Number of dietary items</td>
</tr>
<tr>
<td></td>
<td>0 1 2 3 4 5 6 7 Total</td>
<td>0 1 2 3 4 5 6 7 Total</td>
</tr>
<tr>
<td>Norway</td>
<td>N/A N/A N/A N/A N/A N/A N/A N/A</td>
<td>130 449 583 411 183 40 2 0</td>
</tr>
<tr>
<td>n</td>
<td>746 1029 701 247 65 8 1 0</td>
<td>1798</td>
</tr>
<tr>
<td>%</td>
<td>26.7 38.6 25.1 8.8 2.3 0.3 0.0</td>
<td>2.2 35.5 25.8 11.5 3.8 0.6 0.1 0</td>
</tr>
<tr>
<td>Sweden</td>
<td>203 579 605 372 138 26 0 0</td>
<td>1923</td>
</tr>
<tr>
<td>n</td>
<td>10.6 30.1 31.5 19.3 7.2 1.4 0 0</td>
<td>8.7 26.7 34.4 20.7 7.5 1.8 0.3 0</td>
</tr>
<tr>
<td>%</td>
<td>27.0 36.7 27.0 13.7 4.2 0.4 0 0</td>
<td>12.0 34.6 24.6 21.2 4.9 1.8 0.0 0</td>
</tr>
<tr>
<td>Cambridges</td>
<td>45 99 71 36 11 1 0 0</td>
<td>263</td>
</tr>
<tr>
<td>n</td>
<td>17.1 37.6 27.0 13.7 4.2 0.4 0 0</td>
<td>13.0 34.6 24.6 21.2 4.9 1.8 0.0 0</td>
</tr>
<tr>
<td>%</td>
<td>14.1 50.0 39.1 21.3 12.2 3.1 0.0 0</td>
<td>9.3 52.0 34.1 21.3 4.9 1.8 0.0 0</td>
</tr>
<tr>
<td>Oxford, general population</td>
<td>27 46 42 26 10 0 0 0</td>
<td>151</td>
</tr>
<tr>
<td>n</td>
<td>17.9 30.5 27.8 17.2 6.6 0.0 0 0</td>
<td>16.5 27.7 35.7 15.3 3.6 1.2 0.0 0</td>
</tr>
<tr>
<td>%</td>
<td>17.9 30.5 27.8 17.2 6.6 0.0 0 0</td>
<td>16.5 27.7 35.7 15.3 3.6 1.2 0.0 0</td>
</tr>
<tr>
<td>Oxford, health conscious</td>
<td>13 35 33 27 6 0 0 0</td>
<td>114</td>
</tr>
<tr>
<td>n</td>
<td>11.4 30.7 29.0 23.7 5.3 0.0 0 0</td>
<td>12.1 28.6 32.0 18.5 8.3 0.5 0.0 0</td>
</tr>
<tr>
<td>%</td>
<td>11.4 30.7 29.0 23.7 5.3 0.0 0 0</td>
<td>12.1 28.6 32.0 18.5 8.3 0.5 0.0 0</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>270 495 36.0 125 29 0 0 0</td>
<td>1270</td>
</tr>
<tr>
<td>n</td>
<td>21.3 39.1 27.6 9.8 2.3 0.0 0 0</td>
<td>13.1 35.7 33.6 14.9 2.6 0.1 0.1 0</td>
</tr>
<tr>
<td>%</td>
<td>21.3 39.1 27.6 9.8 2.3 0.0 0 0</td>
<td>13.1 35.7 33.6 14.9 2.6 0.1 0.1 0</td>
</tr>
<tr>
<td>Germany</td>
<td>367 867 683 296 48 7 0 0</td>
<td>2268</td>
</tr>
<tr>
<td>n</td>
<td>16.2 38.2 30.1 13.1 2.1 0.3 0 0</td>
<td>16.7 35.9 31.7 13.1 2.6 0.1 0.1 0</td>
</tr>
<tr>
<td>%</td>
<td>16.2 38.2 30.1 13.1 2.1 0.3 0 0</td>
<td>16.7 35.9 31.7 13.1 2.6 0.1 0.1 0</td>
</tr>
<tr>
<td>France</td>
<td>N/A N/A N/A N/A N/A N/A N/A N/A</td>
<td>827 1693 1416 628 152 17 2 0</td>
</tr>
<tr>
<td>n</td>
<td>214 541 481 185 44 4 0 0</td>
<td>1469</td>
</tr>
<tr>
<td>%</td>
<td>14.6 36.8 32.7 12.6 3.0 0.3 0.0 0</td>
<td>21.6 39.4 25.3 10.8 2.7 0.3 0.0 0</td>
</tr>
<tr>
<td>Italy</td>
<td>360 586 363 112 22 0 1 0</td>
<td>1444</td>
</tr>
<tr>
<td>n</td>
<td>24.9 40.6 25.1 7.8 1.5 0.0 0 0</td>
<td>29.0 43.9 21.3 4.9 0.8 0.1 0.0 0</td>
</tr>
<tr>
<td>%</td>
<td>24.9 40.6 25.1 7.8 1.5 0.0 0 0</td>
<td>29.0 43.9 21.3 4.9 0.8 0.1 0.0 0</td>
</tr>
<tr>
<td>Spain</td>
<td>333 684 524 198 30 8 0 0</td>
<td>1777</td>
</tr>
<tr>
<td>n</td>
<td>18.7 38.5 29.5 11.1 1.7 0.5 0 0</td>
<td>21.9 38.5 27.3 10.3 1.9 0.1 0.0 0</td>
</tr>
<tr>
<td>%</td>
<td>18.7 38.5 29.5 11.1 1.7 0.5 0 0</td>
<td>21.9 38.5 27.3 10.3 1.9 0.1 0.0 0</td>
</tr>
</tbody>
</table>

N/A, not applicable.
allow us to go into detail regarding the wholegrain content and types of grain, we can only speculate about this. In general, the question on ‘dark bread’ is made problematic by the fact that responders may not be aware whether they are consuming wholegrain bread or coloured white bread or white bread baked to a dark crust. This means that the question on ‘dark bread’ covers both baking method and water content, as well as wholegrain content. Also, all bread that is not 100% white is classified as ‘dark’; meaning that bread with very low wholegrain content may be included. Given the poor validity of the dark bread questionnaire data as a proxy for wholegrain intake, one may instead turn to a biomarker of wholegrain intake; namely alkylresorcinols. These have been examined in 2845 EPIC participants from all ten countries. Findings suggest a higher wholegrain intake in Central and Northern Europe compared with the Mediterranean countries\(^{14}\), supporting our hypothesis that ‘dark bread’ may not necessarily include wholegrain bread only. In the Nordic EPIC countries, information about cereal consumption from the 24HDR has been reclassified and detailed information on type and amount of whole grains has been collected. A clear tendency was seen towards a higher intake of wholegrain products, especially wholegrain bread, in Denmark and Norway compared with Sweden whereas the total rye intake was highest in Denmark and Sweden compared with Norway\(^{15}\), suggesting inter-Nordic variation in food habits. This is also reflected in the present study: when comparing the Nordic countries, Swedes seem to present a somewhat different intake of the included items compared with Danes and Norwegians, who have a more similar intake, suggesting that the selected dietary components are more representative of these two countries than of the Swedish diet. This could be due to a stronger Swedish tradition for hot lunches, compared with a stronger tradition for sandwiches in Denmark and Norway.

The present study is based on an a priori approach, including beforehand defined, healthy dietary items. Previously, an a posteriori, data-driven approach has been used to identify dietary items associated with each country in EPIC\(^{2}\), using the specific data at hand as a basis for statistical modelling of associations\(^{16}\). The food items found related to the Nordic countries in the a posteriori approach were almost exclusively items considered harmful in relation to health (e.g. alcohol, soft drinks and processed meat), so that study did not inform on any potential strategies for improving health through local dietary components\(^{2}\). The advantages of our a priori approach is that it identifies not just all food items associated with a country, but specifically maps consumption of likely health-enhancing food items, suggesting entry points for preventive initiatives through dietary modification. The weaknesses of the a priori approach include consideration only of food items defined beforehand, when other food items could possibly also be considered part of a health-enhancing Nordic diet.

There is some discrepancy between the included dietary components in this and previous studies on a healthy Nordic dietary pattern, which have included e.g. rapeseed oil, low-fat dairy products, wild and pasture-fed land-based animals, potatoes, oats and barley\(^{4–6,8,17,18}\).

The a priori selection of dietary items in the present study was based on the criteria mentioned in the introduction, as well as the availability of data in the EPIC cohort. Potatoes and low-fat dairy products were thus not included because their health-beneficial effects are not unequivocal, whereas for the remaining dietary items, we did not have data on these in the 24HDR in all participating countries and were therefore not able to include them.

The use of composite dietary pattern indices in nutritional epidemiology is gaining ground, with the Mediterranean dietary score, defined by high intake of fruits and vegetables, legumes, grains, olive oil and fish, low intakes of meat and poultry and moderate alcohol consumption\(^{19}\), as the forerunner. This pattern has also been proved beneficial outside its traditional geographic regions, including in the Nordic countries\(^{20,21}\). However, adherence to this dietary pattern has been hard to implement in Nordic countries\(^{9}\), suggesting that future dietary campaigns may better focus on regional, healthy dietary items. Our study has shown that some components of the Mediterranean dietary score, such as fish and grains (here equivalent to dark bread consumption), are also part of a Nordic dietary pattern. However, the foods consumed probably refer to different variants, e.g. different fish varieties and dark wheat bread instead of rye bread. But the a priori defined Nordic dietary components investigated in our study also show higher consumption in European regions other than the Nordic: Central European countries had a high intake of berries, cabbages and root vegetables and Southern European countries of apples/pears and shellfish. This suggests that the definition of a health-promoting dietary pattern is possible in each European region or country, taking its starting point in regional, familiar items, which could be used in national health campaigns\(^{18}\). Recently, for instance, a Baltic Sea diet has been suggested\(^{22}\). These regional diets thus seem primarily defined by their ability to be grown locally, strengthening sustainability, rather than their geographical exclusiveness.

The strengths of the present study include the large study base including ten European countries and spanning a wide variety of dietary and lifestyle habits, making it well suited to investigate diet across geographic regions in Europe. Participants are included from as far north as northern Norway to as far south as southern Italy. Furthermore, the data presented here were derived from a standardized 24HDR, based on uniform food composition databases, which reduces the possibility of distortion of
Dietary items defining a Nordic diet observed mean intakes\(^{(25)}\). The 24HDR was developed specifically for this population. It was administered to a sub-sample of participants selected with the purpose of not only being representative of the entire EPIC cohort with regard to sociodemographic and lifestyle factors but also in relation to coverage of days of the week and seasons of the year, where food habits may differ\(^{(11)}\). The 24HDR has the advantage that it is less subject to measurement error as it is easier to remember foods consumed in the last 24h compared with an FFQ, which usually asks about intake over a longer period of time. Finally, the analyses were weighted by day and season of data collection in order to correct for discrepancies in these between centres, as there may be a rather large variation with e.g. season (most likely especially for berries, which is a more seasonally consumed food item). It is possible that this weighting has not completely eliminated day and seasonal variation between centres, but it should have removed most of it.

A limitation of the study was that we only had a single 24HDR measurement per study subject, which limited the accuracy in estimation of intakes of individuals, but does not affect estimation of population means at an aggregate level, which was the main objective of our study. However, the 24HDR was not administered especially with the focus of the present study in mind, leaving deficiencies in the estimation of some dietary components; especially dark bread, but other included components may also suffer from imprecision due to less optimal food grouping or coding. Furthermore, the dietary data in the study were collected between 1995 and 2000\(^{(11)}\). It is possible that the dietary patterns of the participating countries have changed during the last 10–15 years\(^{(23)}\). Finally, the EPIC study is not designed to be representative of the general population in the countries from which participants derive, as they are sampled by convenience and voluntarism rather than representativeness, and consequently generalization of the results to the general population in the same age group should only be done with caution\(^{(10)}\). Unfortunately, no French or Norwegian men were invited to participate, leaving us unable to investigate gender-specific diet in these countries. For most countries, there seems to be some variation between male and female intakes of the selected food items. This could be related to the differences in overall energy intake between sexes, but does not appear to be the explanation when considering the percentage of total food group consumption (Fig. 2).

Conclusion

In conclusion, the results of the present study indicate that components of a healthy Nordic diet are consumed all over Europe, just as the Mediterranean dietary score is not composed of items exclusively consumed in the Mediterranean countries, but rather those characterizing the dietary pattern of the Mediterranean area\(^{(25)}\). Some health-promoting dietary foods are, however, more closely related to a Nordic dietary pattern; this seems especially to be the case for dark bread and root vegetables – primarily driven by a large Danish and Norwegian consumption. Fish seems to be an inherent part of the Mediterranean as well as the Nordic diet. There is scope to further promote these regionally familiar dietary items in future health-promoting campaigns in the Nordic countries as well as outside them, as cabbages, apples/pears, berries and shellfish also seem to be common in different European regions.

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Supplementary material

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References