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The whole grain content of foods consumed in the UK

Angela R. Jones [a,b,*], Kay D. Mann [a,b], Sharron A. Kuznesof [c], David P. Richardson [d], Chris J. Seal [a,c]

[a] Human Nutrition Research Centre, Newcastle University, Newcastle upon Tyne NE2 4HH, UK
[b] Institute of Health and Society, Newcastle University, Newcastle upon Tyne NE2 4HH, UK
[c] School of Agriculture, Food and Rural Development, Newcastle University, Kings Road, Newcastle upon Tyne NE1 7RU, UK
[d] DPR Nutrition Ltd, 34 Grimwade Avenue, Croydon, Surrey CR0 5DG, UK

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ABSTRACT

This study aimed to assess the whole grain (WG) content of foods consumed in the UK which include ingredients that retain all three structural components of the grain, and contained ⩾10% WG. Dietary data from seven studies with 10,474 UK subjects were examined for foods containing WG. The WG content was then determined from ingredient lists, manufacturers' information and recipes. 372 food descriptors from nine food groups (4.4% of all food codes) contained ⩾10% WG. Of these 372 foods, 31.5% contained ⩾51%, 30.6% 25–50%, and 37.9% 10–24% WG dry matter as eaten. The relatively small number of WG foods identified in the total number of foods consumed confirms the low contribution of WG foods to the overall pattern of foods consumed in the UK. Since foods containing <51% WG accounted for the majority of WG food codes identified, recognising the importance of these foods to WG intake is essential.

1. Introduction

There is now extensive observational evidence demonstrating an inverse association between higher whole grain intake and numerous health outcomes (Huang, Xu, Lee, Cho, & Qi, 2015; Ye, Chacko, Chou, Kugizaki, & Liu, 2012). Given the strength of the evidence, whole grain related dietary guidance and health claims have been established in several countries. These highlight the importance of whole grains as a dietary constituent and encourage consumers to incorporate whole-grain foods into the diet on a regular basis (HEALTHGRAIN, 2006; Health Canada, 2007; National Health and Medical Research Council, 2005; NHS Choices, 2010; USDA & USDHHS, 2010).

The Danish Whole Grain campaign has had a positive impact on whole grain intake in Denmark, with the lowest whole grain consumers doubling their intake (Danish Whole Grain Partnership, 2014). However, positive efforts from both governmental agencies and the food industry elsewhere, such as in the UK and US, have had limited success with data indicating that whole grain intake and patterns of consumption at the population level are extremely low (Bachman, Reedy, Subar, & Krebs-Smith, 2008; Mann, Pearce, McKevith, Thielecke, & Seal, 2015; Thane, Jones, Stephen, Seal, & Jebb, 2005, 2007; USDA, 2005). In addition, intake data suggest that foods containing between 10% and 51% whole grain content (i.e. less than the 51% cut-off point used for the purposes of health claims and food labelling in the US) have become an increasingly more important contributor to whole grain consumption (Mann et al., 2015; Thane et al., 2007; USDA, 2005). Making comparisons between populations, establishing how whole grains exert their protective effect, the quantities required for maintaining good health and evaluating the success of health promotion strategies is problematic due to the lack of consistency in the approaches used to quantify intakes. The following definition of 'whole grain' was created and approved by the American Association of Cereal Chemists (AACC) in order to aid consumers and food manufacturers: "Whole grains shall consist of the intact, ground, cracked or flaked caryopsis, whose principal anatomical components – the starchy endosperm, germ and bran – are present in the same relative proportions as they exist in the intact caryopsis" (AACC, 1999). As described by Seal, Jones, and Whitney (2006), however, there are no universally accepted methods for quantifying whole grain intake at the grain, ingredient and food levels, and differences in nomenclature have been used. Given the variation in the approaches used it is clear that a consolidated database based on clear definitions of whole grain and whole-grain ingredients is needed which can be used to quantify whole grain intake more accurately.

* Corresponding author at: Human Nutrition Research Centre, Institute of Health and Society, Newcastle University, Newcastle upon Tyne NE2 4HH, UK.
E-mail address: angela.jones@ncl.ac.uk (A.R. Jones).

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1.1. Aims of study

The purpose of the present study was to use pooled information from a number of population-based studies to identify foods that included whole-grain ingredients which retained all three structural components of the grain. The aim was to identify and catalogue foods consumed in the UK which contained at least 10% whole grain content by weight in order to facilitate quantification of whole grain intake.

2. Methods

Dietary data from the seven studies described in Table 1 were amalgamated and examined for foods containing whole-grain ingredients, and the 'food codes' used in the dietary analysis identified. Whole-grain ingredients were classified as the components of a recipe derived from whole grains. The majority of whole-grain ingredients were flours or processed cereals prepared from the intact grain and contained all three components of the grain (endosperm, germ and bran) as defined by the AACC (1999) and described by Seal et al. (2006). A food was described as a 'whole-grain food' when $\geqslant$10% of the food as eaten was whole grain. Foods containing high amounts of bran and/or germ but not containing all three components of the grain were not included in the list. In the large UK population-based surveys used in this analysis, sweetcorn (maize) was classified as a vegetable and therefore not included as a cereal grain. Values for sweetcorn (as eaten) have been included in our list of whole-grain foods (Supplementary Table 1), for informative purposes. Foods where sweetcorn is a minor ingredient such as quiches and soups have not been included since they would not exceed the 10% threshold for calculation.

Table 2
Percent water and dry matter contents of whole grain ingredients (adapted from Holland et al. (1988) and Food Standards Agency (2002)).

Ingredient	% Water content	% Dry matter
Barley, pearl, boiled[a,b]	69.6	30.4
Barley, whole grain, raw[a]	11.7	88.3
Brown rice (boiled)	66.0	34.0
Brown rice (raw)	13.9	86.1
Oatmeal (quick cook raw)	8.2	91.8
Oatmeal (raw)[a]	8.9	91.1
Rye flour (whole)	15.0	85.0
Spaghetti, wholemeal, boiled	69.1	30.9
Spaghetti, wholemeal, raw	10.5	89.5
Whole/whole-grain cornmeal[a]	12.2	87.8
Wholemeal flour	14.0	86.0

[a] Data derived from Holland et al. (1988).
[b] The authors acknowledge that pearl barley is not whole grain (Seal et al., 2006) however Holland et al. (1988) only present data regarding boiled Barley in the pearled form.

In order to identify foods containing at least 10% dry matter whole grain, the water content (%) and the dry matter whole grain content (%) of whole-grain ingredients were established (Table 2). Using the data in Table 2 and recipe information from Holland, Unwin, and Buss (1988), Holland, Welch, and Buss (1992), the Food Standards Agency (2002), a specialist recipe book for cakes and baked cereal products (Hobson, 2002) or manufacturers (including official website information), the whole grain delivery on a dry matter basis as a percentage of the fresh weight of food was calculated using the equation shown in Fig. 1. Weight losses of food from cooking were taken into account when estimating the percentage whole grain content. For some foods such as breakfast cereals where food codes used in dietary analysis do

Table 1
A summary of investigations used to develop a method for quantifying whole grain intake.

Investigation	Aim	Dietary methodology	n[a]	Total number of foods	Total number of WG[b] foods n (%)
The Dietary and Nutritional Survey of British Adults Gregory, Foster, Tyler, and Wiseman (1990)[c]	To provide comprehensive information on the dietary habits and nutritional status of the British population aged between 16 and 64 years in 1986/7	7-Day weighed dietary record	2086	3848	196 (5.1)
National Diet and Nutrition Survey: people aged 65 years and over Finch, Doyle, Lowe, Bates, Prentice, G., and P. C. (1998)[c]	To provide comprehensive information on the dietary habits and nutritional status of British people aged 65 years and over in 1994/5	4-Day weighed dietary record	1189	2667	126 (4.7)
National Diet and Nutrition Survey: young people aged 4–18 years Gregory, Lowe, Bates, Prentice, Jackson, Smithers, Wenlock, and Farron (2000)[c]	To provide comprehensive information on the dietary habits and nutritional status of young British people aged 4–18 years in 1997	7-Day weighed dietary record	1583	4238	151 (3.6)
The National Diet and Nutrition Survey: adults aged 19–64 years Henderson, Gregory, and Swan (2002)[c]	To provide comprehensive information on the dietary habits and nutritional status of the British population aged between 19 and 64 years in 2000/1	7-Day weighed dietary record	1692	4612	153 (3.3)
The National Diet and Nutrition Survey rolling programme years 1, 2 and 3 Department of Health & Food Standards Agency (2012)	To provide comprehensive information on the dietary habits and nutritional status of the general UK population aged 1.5 years + from 2008 to 2011	4-Day estimated food diary	3073	3659	213 (5.8)
Portion Size Estimation Study Jones (2007)	To estimate the portion sizes of whole grain foods consumed by people aged 16 years and older in 5 studies in Newcastle upon Tyne (1997–2002)	3 and 7-Day food diaries and FFQ[d]	825	2029	65 (3.2)
The CHEW-IT Study Jones (2007)	To investigate the acceptability of and barriers to consumption of whole-grain foods and the effects of increased consumption on heart disease risk factors in people aged 18 years and older in Newcastle upon Tyne (2007)	4-Day food diary[d]	26	914	71 (7.8)

WG, Whole grain; FFQ, Food Frequency Questionnaire.
[a] Number of participants for the purposes of this study.
[b] Foods containing at least 10% whole grain content.
[c] Data provided by C.W. Thane.
[d] Portion sizes estimated using the Atlas of Food Portion Sizes (Nelson et al., 1997).