



The Benefits of Breakfast Cereal Consumption:

A Systematic Review of the Evidence Base



“Regular consumption of breakfast cereals can help ensure an adequate nutrient intake and may assist in reducing the risk of being overweight or developing cardiovascular disease or diabetes.”

Professor Peter Williams, FDAA



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FOREWORD

The value of breakfast consumption for personal health and performance is taken for granted by health professionals and the community in general. Breakfast cereals are obvious contributors to the meal but their specific benefits are largely unquantified. This report seeks to fill that knowledge gap. It is a summary of a comprehensive systematic, evidence-based literature review of more than 230 papers, published over 30 years, on the role of the breakfast cereal category in health. The original paper was published in *Advances in Nutrition*, an internationally recognised publication of the American Society of Nutrition.

The personal and community costs of lifestyle are increasingly making prevention through diet a priority. This makes it critical that recommendations for dietary change are based on the best evidence available and this publication helps to provide it.

Using the strict National Health and Medical Research Council criteria, the paper provides the most thorough assessment of the evidence to date. It has 21 evidence-based statements relating to healthy diets, body weight, obesity, diabetes, cardiovascular disease and bowel health, many of which are as strong as or even stronger than those supporting the Australian Dietary Guidelines for fruit and vegetable consumption.

The overall conclusion is that breakfast cereals play an important role in delivering the health benefits of grain foods to Australian diets. The recent Australian Health Survey data reinforces that breakfast cereals are nutrient rich, with ready-to-eat products providing 18 per cent thiamin, 17 per cent iron, 13 per cent folate, 12 per cent riboflavin, nine per cent fibre intakes – with only four per cent energy, three per cent total sugars and around two per cent sodium.

The focus of this review is on comparisons between breakfast cereal consumers and non-consumers but the breakfast category is a diverse one with a wide range of ready-to-eat products on supermarket shelves. Future work would benefit from considering the role different types of products and grain sources available to consumers. The report acknowledges key knowledge gaps, one of which is the lack of randomised controlled trials to ascertain the range and mechanisms of benefit.

In summary, the report provides a sound basis for promoting public health through consumption of breakfast cereal and is encouraging for future product development.

Dr David Topping
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BREAKFAST CEREAL CONSUMPTION IN AUSTRALIA

DIETARY RECOMMENDATIONS

The Australian Dietary Guidelines recommend adults aged 19 to 70 years consume at least four-to-six serves per day of cereal foods, mostly wholegrain and/or high-fibre varieties. They also summarise the evidence for protective effects of cereal foods (grain foods) in relation to cardiovascular disease, diabetes, excess weight and colorectal cancer.¹

While breakfast cereals are recommended for consumption and there is some information on the health benefits of cereal fibre, there is no specific information provided on the health benefits of breakfast cereals.

CONSUMPTION AND NUTRIENT INTAKES

The recent release of the first nutrition results from the Australian Bureau of Statistics (ABS) Australian Health Survey² show that just over a third of all Australians (36 per cent) consumed ready-to-eat cereals (RTECs) on the day they were surveyed and seven per cent consumed hot porridge style breakfast cereals. A similar result was found in the 2013 ABS CensusAtSchool project,³ which showed 37.8 per cent of students reported having had breakfast cereal for breakfast on the day of the survey. This represents a significant decline from 47.3 per cent in 2008.³

The ABS nutrition results released in 2014 confirm that, as nutrient dense foods, breakfast cereals provide Australians with significant levels of essential nutrients while contributing few kilojoules and very little to total sugars and sodium intakes.²

The data shows that ready-to-eat breakfast cereals are one of the highest sources of dietary iron, contributing approximately 17 per cent to the diets of Australians two years and over, along with 18 per cent of the thiamin, 13 per cent of the folate, 12 per cent of the riboflavin, and nine per cent of the dietary fibre. At the same time, they are contributing just four per cent of total daily kilojoules, three per cent of total sugars, around two per cent of sodium and two per cent of fat intake.

In addition to the nutrients gained directly from breakfast cereal, the milk consumed along with breakfast cereal provides around one-third of the daily milk intake for Australian children.⁴

NUTRIENTS PROVIDED BY BREAKFAST CEREAL²

NUTRIENT	READY-TO-EAT %	HOT PORRIDGE STYLE %	TOTAL %
Protein	2.6	0.9	3.5
Carbohydrate	5.7	1.1	6.8
Total sugars	2.8	0.6	3.4
Starch	8.5	1.5	10.0
Dietary fibre	9.1	1.5	10.6
Total fat	1.5	0.7	2.2
Saturated	0.7	0.7	1.4
Monounsaturated	1.3	0.7	2.0
Polyunsaturated	3.6	1.0	4.6
Linoleic	4.1	1.2	5.3
Alpha-linoleic	1.6	0.3	1.9
Trans	0.3	0.5	0.8
Vitamin B1 (thiamin)	18.1	0.6	18.7
Iron	16.5	1.1	17.6
Folate equivalents	12.7	0.3	13.0
Vitamin B2 (riboflavin)	11.5	1.1	12.6
Zinc	7.3	1.1	8.4
Niacin equivalents	5.9	0.6	6.5
Magnesium	6.3	1.5	7.8
Vitamin B6	3.8	0.4	4.2
Selenium	3.5	0.7	4.2
Phosphorus	3.7	1.5	5.2
Calcium	3.3	1.7	5.0
Vitamin E	3.1	0.2	3.3
Potassium	2.6	1.0	3.6
Sodium	2.1	0.2	2.3
Vitamin C	1.1	0.0	1.1
Iodine	0.7	1.3	2.0
Vitamin A (retinol equivalents)	0.1	0.4	0.5
Vitamin B12	0.0	1.2	1.2

Contributions are per capita including breakfast cereal consumers and non-consumers, aged two years and over.



INTRODUCTION

This report is a summary of the first comprehensive scientific review of the relationship of breakfast cereal consumption to nutrition and health. Published in the international review journal *Advances in Nutrition* in September 2014, **The Benefits of Breakfast Cereal Consumption: A Systematic Review of the Evidence Base** examines published research on breakfast cereals over the past 30 years (to October 2013).⁵

The review was conducted by **Professor Peter Williams, Adjunct Professor of Nutrition & Dietetics, University of Canberra and Honorary Professorial Fellow, University of Wollongong**. It was commissioned by the Australian Breakfast Cereal Manufacturers Forum (ABCMF) in the interest of understanding the evidence base for the role of breakfast cereal in preventative health.

Importantly, the review provides 21 level of evidence statements related to the role of breakfast cereals in nutrient intake, weight, diabetes, cardiovascular disease, hypertension, digestive health, dental and mental health, and cognition. These evidence statements are ranked from A to D, using the methodology and format recommended by the National Health and Medical Research Council (NHMRC).⁶

This report summarises the evidence from the complete peer-reviewed literature review. It covers the contribution of breakfast cereal to healthy diets, body weight, obesity, diabetes, cardiovascular disease and bowel health and looks briefly at emerging areas, including cognitive function and physical activity. The full paper is open access and is available at <http://advances.nutrition.org>.

REVIEW METHODS

- For this review, 'breakfast cereal' was defined to include ready-to-eat breakfast cereal (RTEC), oats/porridge and muesli. Breakfast bars, muesli bars, liquid breakfast products, milk drinks and yoghurt products were excluded.
- The author conducted a systematic review of the published scientific literature from all dates until October 2013, which covers the past 30 years, in the Scopus and Medline databases.
- Only papers on the breakfast cereal category generally were reviewed and not those on individual products, cereal components or properties, such as wholegrains, dietary fibre or glycemic index.
- The review only considered English language publications and it excluded animal studies.
- Of 5,316 articles originally identified in the database searching, a total of 232 were used in the qualitative synthesis.
- Quantitative data was extracted from the relevant papers, including the study methods, populations and outcomes of significance to the review.
- Study quality was examined using the methods of the American Dietetic Association Evidence Analysis Manual, and scored as positive, neutral or negative.
- Using the methodology and format recommended by the Australian National Health and Medical Research Council (NHMRC), summary evidence statements and body of evidence tables were developed to present the main findings with a grading from A-D on the strength of the evidence supporting each one.

LIMITATIONS

- The review was undertaken by a single author. However, the reviewer was experienced in this task having led the evidence reviews that supported the most recent review of the Australian Dietary Guidelines.
- Almost all the studies in the literature on the nutritional impacts of breakfast cereal consumption are cross-sectional in design (mostly of RTEC only) with very few randomised controlled trials, which is a weakness in the evidence base overall.
- The mechanisms for many of the health effects summarised in this review are not always clear. In some cases the fortification profile from added vitamins and minerals may be a factor, but the natural nutrient content of cereals, including inherent bioactive substances such as antioxidants and phytoestrogens, as well as the significant contribution of breakfast cereals to wholegrain and dietary fibre intakes, are also likely to contribute.

SUMMARY EVIDENCE STATEMENTS

According to NHMRC guidance, Grade A evidence is to be trusted to guide clinical practice, Grade B is to be trusted to guide practice in most situations, Grade C provides some support but care should be taken in its application, and Grade D is suggestive, where the body of evidence is weak and therefore the statement should be applied with caution.

Evidence with Grades A, B and C has been used to substantiate recommendations in the Australian Dietary Guidelines. Level D evidence provides indications of relationships, but requires further research findings before it could be used to support claims. For the purposes of this summary report, we have concentrated on the areas for which there are evidence statements ranked A, B or C. The full list of statements, including grade D statements, is available on page 22 of this summary.



BREAKFAST CEREAL CONTRIBUTION TO HEALTHY DIETS

SUMMARY

- Regular breakfast cereal eaters are more likely to meet daily nutrient requirements compared to people who eat breakfast cereal less often, or are non-consumers.
- For children who consume breakfast cereal, there is no difference in their overall daily energy intake whether they consume pre-sweetened breakfast cereals or other breakfast cereals.
- Regularly eating breakfast cereal is associated with diets that are around three-to-four per cent lower in energy from fat.

Intervention studies There have been 11 intervention studies that incorporated additional breakfast cereal into subject diets to determine the impact on macro- and micronutrient intakes. A summary of all 11 studies shows an increase in vitamin and mineral intakes, and decreases in fat, but no consistent effect on daily energy, protein or carbohydrate intakes.

Cross-sectional studies There are 51 studies comparing the nutritional impact of regular breakfast cereal consumption with other breakfast types, 30 of which were in children and 21 in adults. The results from the cross-sectional studies and the randomised controlled trials (RCTs) show very consistent results. Children and adolescents who consume breakfast cereals regularly have daily diets that are:

- Higher in energy from carbohydrate, total sugars, dietary fibre, vitamins A and D, thiamin, riboflavin, niacin, pyridoxine, folate, calcium, iron, magnesium and zinc.
- No different in total energy intake, or energy from protein or sodium.
- Lower in energy from fat.

As almost all of the studies are with RTEC, many of the micronutrient differences are related to the fortification profile, but the increased milk intake would contribute significantly to the higher daily calcium and riboflavin intakes.

THE EVIDENCE

Reviews There have been three major reviews of the contributions of breakfast cereals to nutrient intake and overall good health. These reviews show that compared to people consuming smaller amounts of breakfast cereal or non-consumers, regular breakfast cereal consumers have higher intakes of carbohydrate, higher intakes of total sugars, lower intakes of fat, lower cholesterol intakes and lower serum cholesterol levels, enhanced micronutrient intakes and greater likelihood of meeting micronutrient recommended intakes, higher milk intakes and generally improved nutritional status.

EVIDENCE STATEMENT	REGULAR CONSUMPTION OF BREAKFAST CEREALS IS ASSOCIATED WITH A GREATER LIKELIHOOD OF MEETING RECOMMENDED NUTRIENT INTAKES	
Grade C		
Component	Rating	Notes
Evidence base	Poor	20 Level IV studies (cross-sectional studies) [all positive quality]
Consistency	Excellent	All cross-sectional studies report consistent effect
Clinical impact	Satisfactory	All statistically significant, P<0.05
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

CHILDREN AND ADOLESCENTS WHO EAT BREAKFAST CEREAL REGULARLY:

- Are less likely to have vitamin and mineral intakes below the recommended daily requirements, especially for calcium;
- Have better diets overall, measured by the Healthy Eating Index score;
- Have lower daily cholesterol intakes; and
- Have better nutritional status (assessed by blood measures), especially vitamins thiamin, riboflavin, pyridoxine and iron.

ADULTS WHO CONSUME BREAKFAST CEREALS REGULARLY HAVE DAILY DIETS THAT ARE:

- No different in sodium, total energy intake or energy from protein;
- Higher in energy from carbohydrate, total sugars, dietary fibre, vitamins A and D, thiamin, riboflavin, niacin, pyridoxine, folate, calcium, iron, magnesium and zinc;
- Lower in energy from fat;
- Are less likely to have vitamin and mineral intakes below the recommended daily requirements, especially for thiamin, riboflavin, niacin, folate, vitamin C, calcium, magnesium, iron, zinc and fibre;
- Have better diets overall, measured by the Healthy Eating Index score; and
- Have better nutritional status (assessed by blood measures), especially vitamins thiamin, riboflavin, folate.

BENEFITS OF A BREAKFAST CEREAL MEAL PATTERN

- Eating breakfast cereal facilitates greater milk consumption in children and in adults;
- Those who eat breakfast cereal regularly have higher wholegrain consumption per day, both in children and in adults; and
- Children and adults eating RTEC also eat a greater range of different foods at breakfast meals.



EVIDENCE STATEMENT	REGULAR CONSUMPTION OF BREAKFAST CEREALS IS ASSOCIATED WITH DIETS THAT ARE HIGHER IN VITAMINS AND MINERALS FOR ADULTS, ADOLESCENTS AND CHILDREN	
Grade B		
Component	Rating	Notes
Evidence base	Good	5 Level II studies: RCTs ¹ [all positive quality] 49 Level IV studies: 4 reviews and 45 cross-sectional studies [all positive quality]
Consistency	Good	Of a total of 452 measurements, 85% were increased, none decreased, and 15% were unchanged.
Clinical impact	Satisfactory	All statistically significant, P<0.05
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

¹ RCTs = randomised controlled trials

PRE-SWEETENED VS MINIMALLY SWEETENED CEREALS

Analysis of data from the 2007 Australian National Children's Nutrition and Physical Activity Survey compared the intakes of children aged two to 16 years who consumed pre-sweetened breakfast cereals with 15 per cent or more total sugars (PS) to children who consumed minimally pre-sweetened breakfast cereals (non-PS). It showed that total daily energy and nutrient intakes were not significantly different, including intake of total sugars.

Another analysis of the same data showed that RTECs contributed just seven per cent of the total sugars consumed over the whole day and a recent study of 312 Australian breakfast cereals showed there was no relationship between the total sugars content and the energy density of breakfast cereals, both ready-to-eat and other breakfast types.

EVIDENCE STATEMENT	CONSUMPTION OF BREAKFAST CEREALS DOES NOT INCREASE THE TOTAL DAILY SODIUM INTAKE	
Grade C		
Component	Rating	Notes
Evidence base	Poor	27 Level IV studies (cross-sectional studies) [all positive quality]
Consistency	Good	22 studies report no significant effect; 3 report an increase in total sodium and 2 report a reduction
Clinical impact	Poor	Mostly nil effect
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	CONSUMPTION OF PRE-SWEETENED BREAKFAST CEREALS DOES NOT INCREASE TOTAL DAILY SUGARS INTAKE OF CHILDREN AND ADOLESCENTS	
Grade C		
Component	Rating	Notes
Evidence base	Poor	1 Level II study [positive quality] 4 Level IV studies (cross-sectional studies) [all positive quality]
Consistency	Poor	1 American and 2 US studies report no significant effect; 2 US studies (including RCT) report an increase in total sugars intake for children to 13 years only, but not for adolescents
Clinical impact	Poor	Mostly small differences (0-20g per day total extra)
Generalisability	Good	Studies conducted in Australia and the US
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

WEIGHT GAIN, OVERWEIGHT AND OBESITY

SUMMARY

- Regularly eating breakfast cereal is associated with a lower body mass index (BMI), compared to breakfast skippers or other breakfast consumers.
- Breakfast cereal consumption is associated with 12 per cent lower risk of becoming overweight or obese.
- High-fibre breakfast cereals improve satiety and reduce self-assessed hunger after a meal by up to 76 per cent.
- For children who consume breakfast cereal, there is no difference in their risk of overweight or obesity whether they consume pre-sweetened breakfast cereals or other breakfast cereals.

US male physicians over 13 years. Those consuming at least one serving of breakfast cereal a day gained 48 per cent less weight than those rarely consuming cereals, and the relative risk of becoming overweight (BMI ≥25) was 12 per cent less in regular consumers, over the same period.

While the reviews suggest that people who eat breakfast cereals regularly have a lower BMI and are less likely to be overweight, results from the individual intervention trials included in the reviews are inconsistent, with limited evidence of the causal mechanism. While the benefits appear to be more pronounced among higher-fibre breakfast cereals, there is a need for more large-scale randomised clinical trials to determine possible causation.

Intervention studies There are 16 intervention studies in addition to those in the meta-analysis and the three reviews. Most of these studies are short term and focus only on immediate effects on satiety and next-meal food consumption, with varying – although mostly positive – results. As such, there is a need for larger, long-term intervention trials.

Cross-sectional studies Sixteen additional cross-sectional studies not included in the four systematic reviews were also identified. Three of these studies compared the weight status of consumers of pre-sweetened or non-pre-sweetened RTEC and found no differences in BMI or waist circumference in children and adolescents. This is valuable suggestive information, but results from cohort studies would be ideal to support a firm statement on this issue.

THE EVIDENCE

Meta-analysis A meta-analysis of the effect of breakfast cereal consumption on obesity examined 14 studies in 33,205 children and adolescents and calculated that, compared to low or non-consumers of breakfast cereal, high consumers had a lower mean BMI by 1.13 kg/m² (95 per cent CI: 0.81-1.46, P < 0.0001).

Systematic reviews Three other systematic reviews have been published, with significant overlap between the studies included in these reviews and the meta-analysis noted above. One study examined breakfast cereal consumption and prospective weight change in 17,881



Perhaps the best evidence for a preventive effect of breakfast cereal on weight gain comes from the single cohort study that has examined this; the Physicians' Health Study found those who consumed at least one serve of breakfast cereal per day were 12 per cent less likely to become overweight during 13 years of follow-up. The computed odds ratios from cross-sectional studies in the meta-analysis of studies in children supports those results.

A large number of cross-sectional studies have all reported that breakfast cereal consumption is associated with lower measures of overweight or obesity. Indeed, the consistency of this finding in studies from many different countries in different age groups suggests that there is no need for additional studies of this type to be undertaken.

In terms of mechanisms, it is possible that a breakfast including breakfast cereal, especially one that is higher in fibre, may provide better satiety and prevent overconsumption later in the day. However, while there is evidence to support this hypothetical mode of action, not all studies have shown that total daily energy intakes

are lower when breakfast cereal is consumed. Another possible mechanism could be that breakfast cereal consumption increases energy expenditure via better insulin sensitivity in the morning, but this is unlikely to be a food-specific effect. It may also be that breakfast cereal consumption is a marker for an overall healthy lifestyle and merely indicate eating and physical activity patterns that are more favourable overall for weight maintenance.

Thus there is a need for better-controlled cohort and intervention trials to understand this relationships and there is also insufficient evidence to describe the best types of breakfast cereals to prevent weight gain, although there are suggestions of a greater protective effect of higher fibre and oat cereals in some, but not all, studies.

“The Physicians’ Health Study found those who consumed at least one serve of breakfast cereal per day were 12 per cent less likely to become overweight during 13 years of follow-up.”

Professor Peter Williams, FDAA



EVIDENCE STATEMENT	REGULAR CONSUMPTION OF BREAKFAST CEREALS IS ASSOCIATED WITH A LOWER BMI AND A REDUCED RISK OF BEING OVERWEIGHT OR OBESE IN ADULTS AND CHILDREN	
Grade B		
Component	Rating	Notes
Evidence base	Excellent	4 Level I studies: 1 meta-analysis [positive quality] plus 3 systematic reviews covering 8 RCTs, 6 cohort studies and 15 cross-sectional studies) [2 neutral & 1 positive quality] 14 Level II studies (RCTs) [2 neutral, 12 positive quality] 15 Level IV studies (cross-sectional studies)[all positive quality]
Consistency	Good	All cohort and cross-sectional studies report consistent effect; RCTs results are less consistent
Clinical impact	Satisfactory	OR ² for overweight/obesity = 0.19-0.87 in meta-analysis = 0.88 in cohort study
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	CONSUMPTION OF BREAKFAST CEREAL AS A MEAL OR SNACK REPLACEMENT CAN ASSIST IN WEIGHT LOSS IN ADULTS	
Grade B		
Component	Rating	Notes
Evidence base	Excellent	7 Level II studies (RCTs) [all positive quality]
Consistency	Good	Six of the 7 studies reported a beneficial effect on weight loss
Clinical impact	Good	Range of reported weight loss: 1.9-3.4kg over 6 weeks
Generalisability	Excellent	Populations studied in the body of evidence cover a range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	CONSUMPTION OF PRE-SWEETENED BREAKFAST CEREAL DOES NOT INCREASE THE RISK OF BEING OVERWEIGHT OR OBESE IN CHILDREN	
Grade C		
Component	Rating	Notes
Evidence base	Poor	3 Level IV studies (cross-sectional) [all positive quality]
Consistency	Good	All 3 studies show no difference in weight measures
Clinical impact	Poor	Nil effect
Generalisability	Good	Populations studied in the body of evidence cover includes studies in children in the USA and Australia
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

² OR = odds ratio

DIABETES, GLUCOSE INTOLERANCE AND METABOLIC SYNDROME

SUMMARY

- Consuming wholegrain and high-fibre breakfast cereals is associated with a lower risk of diabetes and can help manage blood glucose levels.
- Eating wholegrain and high-fibre bran-based breakfast cereal every day has been shown to reduce the risk of developing type 2 diabetes by 24 per cent.
- High-fibre breakfast cereals – particularly those high in soluble fibre – may help to manage blood sugars, with research showing plasma glucose is 21-67 per cent lower in people who have eaten a high-fibre cereal for breakfast.

Cross-sectional studies There are three relevant cross-sectional studies. A small Malaysian study with diabetic subjects found an association between oat consumption and better blood glucose control, but no relationship with corn flakes. A US study of young adults reported that RTEC consumers were less likely to be overweight or have elevated serum insulin, but there was a slightly higher glycosylated hemoglobin in those who included RTEC in their breakfasts, and they found no difference in the prevalence of metabolic syndrome. Results from the 2001-2008 USA's National Health and Nutrition Examination Survey (NHANES) showed that compared to breakfast skippers, RTEC breakfast consumers aged 19-51 years were less likely to have elevated blood glucose and metabolic syndrome, but there were no differences in those aged 51-70 years.

Intervention trials There have been 11 relevant short-term studies, 10 of which compared the effect of different breakfast cereals on glucose and insulin responses and one of which compared the effect of high- or low-GI cereals added to the diet of subjects with non-insulin-dependent diabetes mellitus (NIDDM). Several reported improved glucose or insulin responses with oat, barley or psyllium-based cereal or muesli breakfasts compared to other breakfast cereals in diabetic subjects. This effect was also seen in some studies with normal subjects consuming cereals with beta-glucan.

In normoglycemic subjects, higher fibre breakfast cereals seemed to reduce postprandial plasma glucose responses but two studies found no difference between oat- and wheat-based breakfast cereals in this regard. One study found no difference in insulin or glucose responses in subjects with NIDDM whether breakfast cereals were unsweetened or sweetened with 40 per cent sucrose. A study in women fed high- or moderate-GI breakfast cereal breakfasts (77 vs 51 GI) found no differences in plasma glucose or insulin responses and a recent study of 43 Australian breakfast cereals showed that there was no relationship between the sugars content and the GI value of breakfast cereals.

THE EVIDENCE

Meta-analysis There has been one meta-analysis (of 16 cohort studies) on the effect of breakfast cereal consumption on diabetes, and that study compared wholegrains to refined grains generally, with only three of the studies providing sub-analyses on breakfast cereals specifically. It found that the risk of developing type 2 diabetes was lower in those consuming the greatest amounts of wholegrain cereal, and that each additional daily serve of wholegrain breakfast cereal reduced the risk of developing type 2 diabetes by 27 per cent.

Cohort studies There are two other cohort studies that have reported on breakfast cereals – the Melbourne Collaborative Cohort Study and the Whitehall II study. Both found no significant relationship between total breakfast cereal consumption and incident diabetes, although neither study analysed wholegrain and refined grain cereals separately. The Whitehall II study did find that the dietary pattern associated with increased risk of incident type 2 diabetes was characterised by low consumption of medium- and high-fibre breakfast cereals, in addition to high consumption of soft drinks, onions, burgers, crisps and white bread.

EVIDENCE STATEMENT	REGULAR CONSUMPTION OF WHOLEGRAIN AND HIGH-FIBRE BREAKFAST CEREALS IS ASSOCIATED WITH A REDUCED RISK OF DIABETES	
Grade B		
Component	Rating	Notes
Evidence base	Good	1 Level I study (meta-analysis of 3 cohort studies) [positive quality]
Consistency	Good	All studies reported a protective effect from wholegrain breakfast cereal consumption
Clinical impact	Good	RR = 0.76 (95% CI: 0.69-0.84) for daily consumption of whole grain breakfast RR = 0.73 (95% CI: 0.59-0.91) for each additional daily serving.
Generalisability	Satisfactory	Two of the 3 studies were with US health professionals, and it is hard to judge if it is reasonable to generalise to the total population
Applicability	Good	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	CONSUMPTION OF HIGH-FIBRE BREAKFAST CEREALS, ESPECIALLY THOSE HIGH IN SOLUBLE FIBRE, MAY ASSIST IN THE MANAGEMENT OF HYPERGLYCEMIA IN PEOPLE WITH DIABETES	
Grade C		
Component	Rating	Notes
Evidence base	Satisfactory	5 Level II studies (RCTs) [all positive quality] 1 Level IV study (cross-sectional studies) [positive quality]
Consistency	Good	All studies consistent
Clinical impact	Good	Plasma glucose 21-67% lower after high-fibre cereal vs controls
Generalisability	Good	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly



CARDIOVASCULAR DISEASE AND HYPERTENSION

SUMMARY

- Consumption of oat, barley or psyllium-based breakfast cereals can help lower total and low-density lipoprotein (LDL) cholesterol by five per cent.
- Regularly eating wholegrain breakfast cereal is associated with a 20-28 per cent reduced risk of death from cardiovascular disease.

Meta-analyses and reviews There are five meta-analyses of wholegrain foods in general, which have all reported a finding of reduced risk, ranging from 19-30 per cent reductions with intakes of three or more servings a day. Similarly, a meta-analysis of the effect of dietary fibre on blood cholesterol reported significant decreases in total and LDL cholesterol with consumption of oats and psyllium, and a recent meta-analysis concluded that insoluble fibre from cereal sources is inversely associated with risk of coronary heart and cardiovascular disease. A Cochrane review of wholegrains and heart disease noted specifically that eight of the 10 studies were with oats, and that their meta-analysis found effects of lower total cholesterol and LDL cholesterol from oats. There have also been meta-analyses reporting

significant cholesterol-lowering effects of barley and psyllium-enriched cereals. At least eight other systematic literature reviews have all reported a finding of reduced risk of coronary heart disease with oat, barley or psyllium consumption, ranging from 19-30 per cent reductions in cholesterol levels with the highest intakes of three or more servings per day.

Cohort and case-control studies Four cohort studies and one case-control study have reported on cardiovascular disease outcomes with breakfast cereal consumption. One looked at bran-based breakfast cereals and found no relationship with ischemic heart disease incidence, but the other four all reported protective effects from wholegrain breakfast cereal.

Intervention trials Most intervention trials have measured short-term effects on blood lipids or blood pressure and three recent randomised controlled trials (RCTs) with oat-based breakfast cereals have confirmed their cholesterol lowering effects. Wheat-based cereals appear to not have any effect on serum cholesterol. The glycemic index (GI) value of a breakfast cereal does not appear to affect serum total, LDL or high-density lipoprotein (HDL) cholesterol.

HYPERTENSION

The evidence base for hypertension is limited to three RCTs, one cohort and two cross-sectional studies. The Physicians' Health Study found a 19 per cent reduction in hypertension risk with daily breakfast cereal consumption, with a stronger relationship found for wholegrain compared to refined grain cereals. The two cross-sectional studies analysed data from the NHANES national US surveys and found that consumption of ready-to-eat breakfast cereal is associated with a 36 per cent reduction in hypertension risk. Results from the RCTs are less consistent and limited to hypotensive subjects. As a result of the limited evidence base, the findings are at best suggestive that breakfast cereal may reduce risk of hypertension and this has been reflected in the evidence statements.



EVIDENCE STATEMENT	REGULAR CONSUMPTION OF OAT-, BARLEY- OR PSYLLIUM-BASED BREAKFAST CEREALS CAN HELP LOWER TOTAL AND LDL CHOLESTEROL LEVELS	
Grade A		
Component	Rating	Notes
Evidence base	Excellent	6 Level I studies: 3 meta-analysis plus 3 systematic reviews covering over 70 different RCTs [all positive quality] 3 Level II studies: RCTs (2 servings of oat based cereals/d [all positive quality])
Consistency	Excellent	RCTs results show consistent protective effect
Clinical impact	Good	In meta-analyses, reductions ranged from 0.2-0.3 mmol/L (total cholesterol); 0.1-0.35 mmol/L (LDL cholesterol).
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	REGULAR CONSUMPTION OF WHOLEGRAIN BREAKFAST CEREALS IS ASSOCIATED WITH LOWER RISK OF CARDIOVASCULAR DISEASE	
Grade C		
Component	Rating	Notes
Evidence base	Satisfactory	4 Level III studies (3 cohort and 1 case-control) [all positive quality] 1 Level IV study (cross-sectional) [all positive quality]
Consistency	Good	Most studies consistent. Lack of effect in one cohort study may be due to low background risk in the vegetarian cohort and limited diet intake data.
Clinical impact	Good	RR for CVD death: 0.72-0.80 OR for IHD incidence: 0.38
Generalisability	Good	Populations studied in the US, UK and Norway
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

EVIDENCE STATEMENT	REGULAR CONSUMPTION OF BREAKFAST CEREALS IS NOT ASSOCIATED WITH AN INCREASED RISK OF HYPERTENSION	
Grade C		
Component	Rating	Notes
Evidence base	Satisfactory	3 Levels II studies (RCTs) [all positive quality] 1 Level III study (cohort) [positive quality] 3 Level IV studies (cross-sectional studies) [all positive quality]
Consistency	Excellent	None show increased blood pressure or risk of hypertension
Clinical impact	Poor	Nil effect
Generalisability	Satisfactory	The largest cohort study and one of the RCTs are both in men only
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

DIGESTIVE AND GUT HEALTH

SUMMARY

- Eating high-fibre, wheat-based breakfast cereals helps to prevent constipation and improve bowel function increasing regularity by at least 25 per cent.

THE EVIDENCE

The effect of dietary fibre on stool weight has been estimated in a meta-analysis of over 100 studies. Breakfast cereals provide eight to 12 per cent of the dietary fibre in adult diets in the USA, Britain and Australia and therefore have an important role in supporting healthy laxation, but clearly this varies depending on the type of breakfast cereal and its fibre content.

Four randomised trials and one cross-sectional study have directly examined the association of breakfast cereal consumption with digestive problems and consistently found that breakfast cereals can improve constipation, decrease stool hardness and improve digestion.

In addition, several studies have shown that adding dietary fibre, via bran or other means, to breakfast cereals in institutional settings such as nursing homes can alleviate problems of constipation.



EVIDENCE STATEMENT	CONSUMPTION OF HIGH-FIBRE WHEAT-BASED BREAKFAST CEREALS HELPS PREVENT CONSTIPATION AND IMPROVES BOWEL FUNCTION	
Grade A		
Component	Rating	Notes
Evidence base	Good	5 Level II studies (RCTs) [2 positive quality; 2 neutral, 1 negative] 1 Level IV study (cross-sectional) [all positive quality]
Consistency	Good	All clinical trials report improvements in stool frequency, bulk and transit time. One cross-sectional study found no relationship with consumption, but this was with of all types of breakfast cereals, not just high-fibre.
Clinical impact	Good	Stool frequency increased on average by at least 25%
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly

DENTAL HEALTH

Three published studies have examined the relationship between breakfast cereal consumption and dental health in children and adolescents. All three studies showed no relationship between breakfast cereal consumption.

Interestingly, in all three studies, the incidence of dental caries was actually lower among cereal consumers, although this was not a significant finding. This might be related to the known role of breakfast cereal consumption in promoting high milk intakes.

EVIDENCE STATEMENT	CONSUMPTION OF BREAKFAST CEREALS BY CHILDREN IS NOT ASSOCIATED WITH INCREASED RISK OF DENTAL CARIES	
Grade B		
Component	Rating	Notes
Evidence base	Satisfactory	2 Level II studies (RCTs) [1 positive quality; 1 neutral] 1 Level IV study (cross-sectional) [positive quality]
Consistency	Excellent	All studies show no significant association (if anything, a trend to lower caries incidence with cereal consumption)
Clinical impact	Poor	No effect
Generalisability	Excellent	Populations studied in the body of evidence cover a wide range of ages and countries of residence
Applicability	Excellent	Directly applicable in populations where breakfast cereals are consumed regularly



EMERGING AREAS

All cause mortality Two cohort studies have examined the relationship of breakfast cereal consumption to overall mortality. The Adult Seventh-day Adventists study found the most frequent breakfast cereal consumers had a reduced risk of death from all causes of 16 per cent compared to the least frequent consumers, on a 21-year follow-up. The US Physicians' Health Study found a 17 per cent reduction in total mortality with wholegrain breakfast cereal intake at 5.5 years but not with refined grain breakfast cereal intake or total cereal intake. The results from the Adventist study are very similar to those for wholegrain cereals in the Physicians' Health Study, which may reflect a likely preference for wholegrain cereals in the former group.

Cancer While there have been no reviews specifically on the impact of breakfast cereal consumption on cancer risk, a total of 13 studies (five cohorts, five case-control and three RCTs) have examined the effect of breakfast cereals with a range of cancer types, including colorectal, lung, endometrial, breast, prostate and pancreas. In none of the studies reporting all cancer or lung, colorectal, breast or endometrial outcomes was breakfast cereal intake related to cancer risk. One study did identify an increased risk for pancreatic cancer in cooked but not cold cereal, and another for prostate cancer from wholegrain but not refined grain cereals. There are no plausible mechanisms for these findings and more research is required before firm conclusions made.

Mental health This review identified seven cross-sectional studies and nine intervention trials that examined the effects of a breakfast cereal on mood, stress, anxiety and depression. All the cross-sectional studies suggest that regular breakfast cereal consumers have lower levels of mental health problems, including less stress, anxiety and depression. However, with studies of this type there is always the possibility of reverse causality – that stress and mental health problems lead to changes in diet – therefore intervention studies are particularly important. Three of the intervention studies compared breakfast cereal consumption to no breakfast, so it is not possible to draw any conclusions about the type of breakfast food. Two other studies used high-fibre wheat-based cereals in the intervention, and while they showed some positive results, the applicability to breakfast cereals in general is uncertain. Given the diverse interventions and outcome measures used in these studies, much more research is needed to understand the relationships between mental wellbeing and breakfast cereals.

Cognitive performance Breakfast consumption may improve cognitive function related to memory, test grades and school attendance. However, there is a lack of research comparing breakfast type. Seven RCTs have looked at the effect of breakfast cereals on different measures of mental performance: one in adults, the others in children and adolescents. The adult study found the best alertness after a bran breakfast cereal, which is known to have a low glycemic index (GI). Four of the studies in children compared high and low GI breakfast meals. It is difficult to summarise the results from these studies due to the variety in the outcome measures. It does appear that the consumption of low GI breakfast cereals may be beneficial for some aspects of the cognitive functioning of children and adolescents, but more research in this area is needed.

Physical activity One of the explanations for the observed association of breakfast cereal consumption with lower BMI is the association with lifestyle habits such as greater physical activity and reduced television watching. One prospective cohort study in the US showed that girls who ate cereal more often were more likely to exhibit high levels of physical activity and less television viewing. Another cross-sectional study in Greece with school children aged 12-17 years reported a similar relationship. Multiple regression analysis revealed consumption of breakfast cereals was associated with a higher likelihood of participation in more physical activity. However, it is uncertain whether there is anything causal in this relationship: it is very possible that families who promote cereal eating also encourage more healthy lifestyles in general.

Performance A few clinical studies have used breakfast cereals to examine the effect of foods provided before exercise performance. All these studies were with young active people and the performance testing regimes were prolonged and strenuous, so their relevance for the normal population in everyday activities is uncertain. Only two of these studies compared more than one breakfast cereal and the only significant difference was in the trial that compared rolled oats with puffed rice. The authors assume this difference is due to the GI of the products, but there have been no studies comparing foods of similar nutritional content with different GI values.

Other effects There is some limited research on breakfast cereals and probiotic effects, immune function, exercise recovery and anemia, but the information is too preliminary to draw any firm conclusions.



SUMMARY EVIDENCE STATEMENTS

OVERALL DIETS	EVIDENCE GRADE
Regular consumption of breakfast cereals is associated with diets that are higher in vitamins and minerals for adults, adolescents and children	B
Regular consumption of breakfast cereals is associated with diets that are lower in fat	B
Regular consumption of breakfast cereals is associated with a greater likelihood of meeting recommended nutrient intakes	C
Consumption of breakfast cereals is associated with higher daily milk intake	C
Consumption of pre-sweetened breakfast cereals does not increase the total daily energy intake in children's diets	C
Consumption of pre-sweetened breakfast cereals does not increase total daily sugars intake in children and adolescents	C
Consumption of breakfast cereals does not increase the total daily sodium intake	C
WEIGHT GAIN, OVERWEIGHT AND OBESITY	
Regular consumption of breakfast cereal is associated with a lower BMI and a reduced risk of being overweight or obese in adults and children	B
Consumption of breakfast cereals as a meal or snack replacement can assist in weight loss in adults	B
Consumption of pre-sweetened breakfast cereal does not increase the risk of being overweight or obese in children	C
Consumption of high-fibre breakfast cereals improves satiety and reduces hunger after a meal	C
DIABETES, GLUCOSE INTOLERANCE AND METABOLIC SYNDROME	
Regular consumption of wholegrain and high-fibre breakfast cereals is associated with a reduced risk of diabetes	B
Consumption of high-fibre breakfast cereals, especially those high in soluble fibre, may assist in the management of hyperglycemia in people with diabetes	C
Regular consumption of breakfast cereals is associated with a reduced risk of diabetes	D
CARDIOVASCULAR DISEASE AND HYPERTENSION	
Regular consumption of oat-, barley- or psyllium-based breakfast cereals can help lower total and LDL cholesterol levels	A
Regular consumption of wholegrain breakfast cereals is associated with a lower risk of cardiovascular disease	C
Regular consumption of breakfast cereals is not associated with an increased risk of hypertension	C
Regular consumption of breakfast cereals is associated with lower total and LDL cholesterol levels	D
Regular consumption of breakfast cereals may reduce the risk of hypertension	D
DIGESTIVE AND BOWEL HEALTH	
Consumption of high-fibre wheat-based breakfast cereals helps prevent constipation and improves bowel function	A
DENTAL CARIES	
Consumption of breakfast cereals by children is not associated with increased risk of dental caries	B

CONCLUSION

The Benefits of Breakfast Cereal Consumption:

A Systematic Review of the Evidence Base reviews published research on breakfast cereals over the past 30 years to determine outcomes related to nutrient intake, weight, diabetes, cardiovascular disease, hypertension, digestive health, dental and mental health, and cognition.

The research shows that:

- Regularly eating breakfast cereal is associated with diets that are around three to four per cent lower in energy from fat.
- Regularly eating breakfast cereal is associated with a 12 per cent lower risk of becoming overweight or obese and a lower BMI – compared to breakfast skippers and other breakfast eaters.
- High-fibre breakfast cereals improve satiety and reduce self-assessed hunger after a meal by up to 76 per cent.
- Eating wholegrain and high-fibre bran-based breakfast cereal every day is associated with a 24 per cent reduced risk of developing type II diabetes.
- High-fibre breakfast cereals – particularly those high in soluble fibre – may help to manage blood sugar, with research showing plasma glucose is 21-67 per cent lower in people who have eaten a high-fibre cereal for breakfast.
- Consumption of oat, barley or psyllium-based breakfast cereals can help lower total and LDL cholesterol by up to 0.3mmol/L (about five per cent).
- Regularly eating wholegrain and high-fibre bran-based breakfast cereal is associated with a 20 to 28 per cent reduced risk of death from cardiovascular disease.
- Eating high-fibre, wheat-based breakfast cereals helps to prevent constipation and improves bowel function, increasing regularity by at least 25 per cent.

The regular consumption of breakfast cereals can help ensure an adequate nutrient intake and may assist in reducing the risks of being overweight, or developing cardiovascular disease or diabetes. They are relatively inexpensive, nutrient-dense and convenient foods, which are recommended as part of a healthy balanced diet.

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ABOUT THE AUSTRALIAN BREAKFAST CEREAL MANUFACTURERS FORUM (ABCMF)

The ABCMF is a forum of the Australian Food and Grocery Council. It provides evidence-based, practical information so Australians can have a better understanding of the value of breakfast and the benefits of eating breakfast cereal as part of a healthy lifestyle.

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