Increased breakfast frequency and nutritional quality among schoolchildren after a national breakfast promotion campaign in Australia between 2000 and 2006

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Abstract
This national study examined student breakfast consumption and nutritional quality of breakfast in 2000 and 2006 by gender, school grade, school socioeconomic status (SES) and weight status after the implementation of a national breakfast promotion campaign. Participants were 4237 schoolchildren in grades 2–12 from 32 schools in 2000 and 5645 schoolchildren from the same schools in 2006. Height and weight were measured. Missing breakfast decreased from 2000 to 2006 in primary school females (9.6–6.0%) and males (9.4–6.0%) and in secondary school females (27.7–18.7%) and males (19.9–12.1%). Breakfast skipping was greater and nutritional quality was poorer in students from low SES schools in both study years but significant improvement was seen from 2000 to 2006 among all SES groups. Overweight/obese participants were more likely than normal weight students to miss breakfast in 2000 (20.7% versus 16.0%) and in 2006 (14.3% versus 10.4%) but significant improvement was observed over the 6-year study period. Findings suggest that the consistent, significant and far-reaching improvements in breakfast consumption observed in this study were attributed to the breakfast promotion program conducted in each school community and disseminated nationally via a mass media campaign.

Introduction
Comparisons of studies among school-aged children indicate that breakfast consumption is more beneficial to cognitive function and academic performance than skipping breakfast, particularly in those whose nutritional status is compromised [1–3]. Recent reviews and experimental studies present a working hypothesis that a breakfast of low glycemic index (GI) is beneficial to the blood glucose supply to the brain and that this effect is likely to explain the positive relationship between breakfast consumption and the cognitive and academic performance of schoolchildren [1, 4–6]. For example, nutritious low GI breakfasts were recently associated with better academic performance in several studies of well-nourished children in Westernized countries [6–10]. A well-designed crossover trial that controlled for several socioeconomic variables demonstrated the positive short-term effects of breakfast on cognitive performance, visuospatial memory and self-reported alertness of high school students in Germany [11]. A brain imaging trial from Japan demonstrated that the type of breakfast staple (e.g. rice versus bread) affects the gray and white matter volumes, IQ and cognitive function of healthy, well-nourished children and that this affect is most likely explained by the benefits of consuming a low GI breakfast [5]. Other studies suggest that the positive impact of school breakfast programs is explained by the fact that providing school breakfast simply encourages children to attend school [2].
Several studies have also shown that breakfast provides significant contributions to the daily intake of nutrients [12, 13] and that children and adults who miss breakfast are likely to limit their intake of nutrients [14].

Breakfast skipping has also been associated with an increased risk of overweight and obesity [15–18]. A study from the United States conducted by Berkey et al. [19] in 2005, reported that children who never ate breakfast were heavier than those children who ate breakfast nearly every day. These findings are supported by similar results from recent large studies conducted in Europe [17], the United States [20] and Australia [21], the latter of which reported that nutritional quality of breakfast and socioeconomic status (SES) were the principal predictors of students' body mass index (BMI).

The contribution of breakfast to nutrient intake of children and adolescents and the associations with overweight and obesity prevention highlight the need for increased parental awareness of the importance of breakfast for children and adolescents as well as the need for improved school-based health education about the many benefits of breakfast.

The promotion of breakfast has particular relevance in countries that do not provide school meals, like Australia, New Zealand and Denmark, where proof of the effectiveness of school-based breakfast and lunch programs is needed. Without sufficient evidence, health educators will find it difficult to engage all stakeholders, including parents, educators and politicians in securing the provision of balanced food to children during school days. The aim of the current study was to examine the cross-sectional trends in breakfast consumption and quality between two nationally representative samples of schoolchildren in 2000 and 2006. The research evolved as an opportunistic and naturalistic study in that the two national studies had taken place before and after the implementation of the breakfast promotion activities and, hence, provided a basis on which to examine their impact. The current study presents an opportunity to assess breakfast trends as well as to observe any impact of the concurrent implementation of several national breakfast promotion activities and a television advertising campaign. The study specifically sought to examine breakfast consumption and quality by three factors: gender, school year and school SES.

**Methods**

**Participants**

Participants were schoolchildren in school years 2–12 (aged 7–18 years) from a national sample of 32 schools in 2000 ($N = 4237$; 2082 male and 2155 female) and 2006 ($N = 5645$; 2720 male and 2925 female). Participating schools were randomly selected from every state and territory of Australia in 2000 and were widely dispersed and representative of the Australian population. Details of the representativeness of the national samples are given in a previous paper [22]. Class groups were randomly selected within each school. Schools included a mix of public ($N = 25$), Catholic ($N = 5$) and private ($N = 2$) primary and secondary schools. The 2000 data for this study were collected and are described as part of the National Nutrition and Physical Activity Study [21] and the 2006 data were collected and described as part of the National Youth Cultures of Eating Study [22].

The SES of schools was categorized as low, middle or high as determined systematically and objectively by each state Department of Education using an aggregate assessment of family income, parental education, parental employment and parental occupation [23]. The procedure to determine school SES was repeated in 2006 to assess whether school SES status had changed over the 6-year period. School SES did not change between 2000 and 2006. Participation was high in both studies with an average of 82% of participants agreeing to complete the questionnaires and have the anthropometric measurements taken.

The study design and protocol were approved by the University of Sydney Human Ethics committee and by each of the Australian state or territory Departments of Education.

**Measurements**

The questionnaire was completed by students during regular class times under the supervision of the first
author and research assistants. Informed consent was obtained from parents and verbal consent was obtained at the time of survey from each student. The questionnaire [21, 22] collected demographic details of the students’ gender, age, school grade/year (years 2–12), usual breakfast consumption patterns (On most days, do you usually eat or drink something for breakfast? Yes/No), breakfast consumption on the day of the study (Did you eat or drink something for breakfast today? Yes/No) and contents of breakfast consumed (Write down what you ate/drank for breakfast today. Write “nothing” if you had nothing at all to eat or drink today). Each student’s quality of breakfast assessment was checked and debriefed face to face with the student by a dietitian or trained research assistant. The students’ height and weight were then measured in private and recorded by the research assistants.

The nutritional quality of breakfast score (Table I) was calculated as a range from 0 to 10 in order to calculate a general breakfast food group score [21] reflecting the combination of the major five food groups (grains/breads/cereals; milk/cheese/yogurt; fruit; vegetables; protein/meats/egg/beans/nuts) as well as adequate sources of major nutrients. Each participant’s breakfast score was individually assigned by a dietitian based on an assessment of the five major food groups and several major nutrients as shown in Table I.

The validity of the breakfast score data in relation to micro- and macronutrient data was confirmed using a validation study of 133 randomly selected participant dietary records that were analyzed by a dietitian using the “Food Works” dietary analysis program [24]. The specific nutrient analysis data for each student’s breakfast were then compared with their breakfast score using Spearman Correlation coefficients as per the dietary validation methods reported by Watson et al. [25]. Internal reliability analyses performed on the breakfast score and the vitamins and minerals confirmed that the inter correlations among these test items were high with a Cronbach’s alpha of 0.86 for the breakfast score and the micronutrients [B group vitamins, Vitamins A–E, calcium (Ca), potassium (K), magnesium (Mg), phosphorus (Ph), iron (Fe), iodine (I) and zinc (Zn)]. Cronbach’s alpha for the internal reliability between the breakfast score and the macronutrients (carbohydrate, dietary fiber, fats, protein) was also high at 0.88. Alpha correlations between the breakfast score and specific nutrients were statistically significant at $P < 0.001$ as follows—kilojoules 0.55, protein 0.59, carbohydrate 0.49, dietary fiber 0.38, fat 0.49, cholesterol 0.38, sugars 0.42, starch 0.42, water 0.48, B group vitamins 0.44, Vitamin D 0.60, Retinol 0.57, K 0.59, Mg 0.57, Ca 0.69, Ph 0.61, Fe 0.69, Zn 0.68 and I

### Table I. Nutritional quality of breakfast score based on the five food groupings and major nutrients

<table>
<thead>
<tr>
<th>Score</th>
<th>Food groupings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Nothing to eat or drink</td>
</tr>
<tr>
<td>1</td>
<td>Non-nutritious fluids only (excluding milk or juice), e.g. tea, coffee, water and soft drink</td>
</tr>
<tr>
<td>2</td>
<td>Sweets, candy, cookies, chips, chocolate</td>
</tr>
<tr>
<td>3</td>
<td>Grain/bread/cereal food group (e.g. toast, rice) or fruit/vegetable food group (e.g. juice, fruit, vegetable)</td>
</tr>
<tr>
<td>4</td>
<td>Grain/cereal food group + Vitamin C source (e.g. toast + juice, crackers + fruit juice or Protein food group/milk food group (e.g. eggs or glass of milk)</td>
</tr>
<tr>
<td>5</td>
<td>Protein food group + Vitamin C source (e.g. eggs + juice, baked beans + juice, bacon + fruit)</td>
</tr>
<tr>
<td>6</td>
<td>Grain/cereal food group + protein food group (e.g. toast + eggs, baked beans on toast, toast with peanut butter) or grain/cereal food group + calcium food source (e.g. cheese on toast or protein food group + calcium food source (e.g. eggs + milk)</td>
</tr>
<tr>
<td>7</td>
<td>Grain/cereal food group + protein food group + Vitamin C source (e.g. toast + eggs + juice) or protein food + calcium food + Vitamin C source (e.g. yogurt + juice)</td>
</tr>
<tr>
<td>8</td>
<td>Grain/cereal food + protein food such as egg, meat, peanut butter, cheese + calcium food source such as milk, cheese, yogurt (e.g. toast + eggs + milk, cereal with milk on top, toast with egg or cheese or meat or peanut butter and a drink of milk)</td>
</tr>
<tr>
<td>9</td>
<td>All the above plus a source of Vitamin C (e.g. fruit or juice), that is, cereal + protein + Vitamin C + calcium (e.g. cereal with milk on top + juice, toast + yoghurt + juice, egg on toast with juice, cheese and tomato on toast, baked beans on toast plus juice)</td>
</tr>
<tr>
<td>10</td>
<td>All the above with low fat option, such as grain/cereal food + protein food + Vitamin C source + calcium food (e.g. cereal with low fat milk + juice; egg on toast with fruit and low fat milk).</td>
</tr>
</tbody>
</table>
Non-significant correlations were found for Vitamin C 0.01, Vitamin E —0.06 and total folate 0.06.

Data collection
A pilot study was undertaken in 1999 among 383 students aged 6–18 years at five randomly selected schools prior to the 2000 study [21], to examine the reading level, content validity and face validity of the questionnaire as well as internal reliability and consistency for each questionnaire item. Minor changes to clarify and simplify the language of the questionnaire were then implemented.

Height and weight were measured by the first author and trained research assistants using standardized anthropometric procedures. Height was measured to the nearest 0.5 cm without shoes or socks using a portable free standing Harpenden stadiometer. Weight was measured to the nearest 0.1 kg using portable Soelne digital scales. Students were weighed in light school uniform, after removing shoes, jackets and emptying their pockets. Overweight and obesity in 2000 and 2006 were derived using the International Obesity Task Force 0.5-year BMI cut-offs [26]. A combined category of overweight and obese was created by adding the obese and overweight prevalence to form categories of ‘overweight/obese’ and ‘normal’ weight.

Breakfast promotion campaign
The implementation of a national breakfast promotion activities took place on an ad hoc basis during 2000–2006 and, hence, provided a naturalistic experiment in which to examine the trends in breakfast consumption during the same study period. The breakfast promotion activities were conducted independently by the author and by the Dietitian’s Association of Australia [27]. First, the author produced a report for every individual school containing the findings of the 2000 survey. Each school principal was sent a report in early 2001. The results were presented for each school grade and provided a comparison of their individual school results with the national averages. An electronic version of the results was also supplied in order to have the results presented to parents, teachers and students in the wider school community via the parents’ association meetings and the school newsletter. All 32-school principals participated in a telephone interview in which they were asked to indicate the changes that had been implemented at their school between 2000 and 2006. A copy of a nutrition education book [28] was mailed to each school principal and school canteen manager, with suggestions that it be used to provide classroom lessons about nutrition and ideas for a breakfast menu at each school canteen. Suggestions were made for the introduction of school breakfast menu items and breakfast programs. A national mass media publicity campaign was conducted by the author during April–June 2003 to promote the study findings and to engage parents and school administrators in a broader community discussion about the importance of breakfast. A total of 142 print media reports were produced and 35 interviews were conducted via radio and television. A 30-s television community service advertisement was produced by the Dietitian’s Association of Australia [27], and this was regularly screened during prime television viewing hours from August 2003. The purpose of the advertisement was to convey a message directly to parents about the importance of a nutritious breakfast in maximizing children’s classroom concentration and academic performance. A follow-up telephone survey with each school principal produced the following descriptive evaluation: all the school principals received the report and subsequently discussed the findings with their school staff, Parents and Citizens Association and students; all school newsletters contained a summary of the study findings with a message to parents about the importance of breakfast and eight of the primary schools introduced a before school breakfast program.

Statistical analyses
Completed questionnaires were cleaned, checked for errors, had missing data labeled as such and data were then entered to produce an SPSS database [29]. Descriptive statistical analyses were undertaken to provide details of the prevalence of usual breakfast
consumption; consumption on the day of the study and the nutritional quality of breakfast score. Chi-square analyses were undertaken to examine the difference between breakfast consumption patterns in 2000 and 2006; these analyses also examined differences between males and females in different school year and SES groups and differences between 2000 and 2006 data. Differences in nutritional quality of breakfast data were examined using univariate analysis of variance (ANOVA) controlling for age as a covariate and using a Bonferroni adjustment to determine differences between multiple group comparisons. Post hoc Fisher least significant difference (LSD) tests were applied after examination of ANOVA results in order to examine differences between different groups of means.

**Results**

The current study presents an opportunity to assess breakfast trends as well as to observe any impact of the concurrent implementation of several national breakfast promotion activities and a television advertising campaign. The study specifically sought to examine breakfast consumption patterns and quality in 2000 to 2006 by three factors: gender, school year and school SES.

### Breakfast consumption in 2000 and 2006 by gender and school SES

Gender differences in usual consumption of breakfast were present in secondary school students (Years 7–12) but not in primary school students (Years 2–6) in both 2000 and 2006. Overall, more females than males reported that they usually miss breakfast in 2000 (14.5 versus 9.2%, \( \chi^2 = 26.6, P < 0.0001 \)) and 2006 (19.0 versus 11.6%, \( \chi^2 = 59.0, P < 0.0001 \)) respectively. Females in secondary school were significantly more likely than males to report that they usually miss breakfast, in both 2000 (23.6 versus 13.0%, \( \chi^2 = 27.3, P < 0.0001 \)) and 2006 (24.4 versus 14.0%, \( \chi^2 = 60.5, P < 0.0001 \)). However, the gender difference was not statistically significant in primary school students in 2000 (4.6 versus 5.1%, \( \chi^2 = 0.09 \), non-significant (NS)) or 2006 (7.8 versus 9.0%, \( \chi^2 = 0.90 \), NS).

### Table II. Comparison of breakfast consumption on the day of the study between 2000 and 2006 among male and female participants in school years 2–12

<table>
<thead>
<tr>
<th>School year</th>
<th>2000 (N = 2082), % (N)</th>
<th>2006 (N = 2720), % (N)</th>
<th>( \chi^2 )</th>
<th>2000 (N = 2155), % (N)</th>
<th>2006 (N = 2925), % (N)</th>
<th>( \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
<td>Yes No</td>
<td>Yes No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>60.0 (3) 40.0 (2)</td>
<td>100 (13) 0 (0)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>91.0 (171) 9.0 (17)</td>
<td>94.5 (257) 5.5 (15)</td>
<td>2.14</td>
<td>95.6 (175) 4.4 (8)</td>
<td>97.2 (244) 2.8 (7)</td>
<td>0.79</td>
</tr>
<tr>
<td>4</td>
<td>90.8 (187) 9.2 (19)</td>
<td>92.8 (220) 7.2 (17)</td>
<td>0.82</td>
<td>93.4 (255) 6.6 (18)</td>
<td>94.9 (224) 5.1 (12)</td>
<td>0.53</td>
</tr>
<tr>
<td>5</td>
<td>91.3 (242) 8.7 (23)</td>
<td>89.9 (241) 10.1 (27)</td>
<td>0.31</td>
<td>88.7 (236) 11.3 (30)</td>
<td>93.7 (238) 6.3 (16)</td>
<td>3.99</td>
</tr>
<tr>
<td>6</td>
<td>88.9 (201) 11.1 (25)</td>
<td>91.2 (238) 8.8 (23)</td>
<td>0.69</td>
<td>86.1 (223) 13.9 (36)</td>
<td>90.0 (233) 10.0 (26)</td>
<td>1.83</td>
</tr>
<tr>
<td>7</td>
<td>85.7 (203) 14.3 (34)</td>
<td>87.8 (454) 12.2 (63)</td>
<td>0.68</td>
<td>83.4 (186) 16.6 (37)</td>
<td>84.1 (435) 15.9 (82)</td>
<td>0.80</td>
</tr>
<tr>
<td>8</td>
<td>81.6 (204) 18.4 (46)</td>
<td>87.6 (324) 12.4 (46)</td>
<td>4.20*</td>
<td>74.7 (183) 25.3 (62)</td>
<td>83.0 (365) 17.0 (75)</td>
<td>6.04*</td>
</tr>
<tr>
<td>9</td>
<td>81.9 (217) 18.1 (48)</td>
<td>85.1 (302) 14.9 (53)</td>
<td>1.13</td>
<td>69.6 (179) 30.4 (78)</td>
<td>82.8 (356) 17.2 (74)</td>
<td>16.12***</td>
</tr>
<tr>
<td>10</td>
<td>74.8 (220) 25.2 (74)</td>
<td>83.4 (291) 16.6 (58)</td>
<td>7.16**</td>
<td>65.0 (147) 35.0 (79)</td>
<td>79.9 (303) 20.1 (76)</td>
<td>16.50***</td>
</tr>
<tr>
<td>11</td>
<td>70.7 (29) 29.2 (12)</td>
<td>80.3 (49) 19.7 (12)</td>
<td>1.25</td>
<td>61.1 (33) 38.9 (21)</td>
<td>76.3 (87) 23.7 (27)</td>
<td>4.22*</td>
</tr>
<tr>
<td>12</td>
<td>69.2 (9) 30.8 (4)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>65.5 (19) 34.5 (10)</td>
<td>64.3 (9) 35.7 (5)</td>
</tr>
<tr>
<td>Total</td>
<td>84.7 (1686) 15.3 (304)</td>
<td>88.4 (2389) 11.6 (314)</td>
<td>13.43***</td>
<td>81.2 (1639) 18.8 (379)</td>
<td>86.2 (2509) 13.8 (400)</td>
<td>22.77***</td>
</tr>
</tbody>
</table>

\( \chi^2 \) performed separately for males and females as 2 \times 2 tables comparing proportions in 2000 and 2006. ‘—’ indicates cell counts too low (less than 5) to perform \( \chi^2 \).

*P < 0.05, **P < 0.01, ***P < 0.001.
The actual consumption of breakfast on the day of the study produced similar gender differences as the reported usual consumption of breakfast, with all females more likely to miss breakfast on the day of the study in 2000 (18.8 versus 15.3%, \( \chi^2 = 8.45, P < 0.01 \)) and in 2006 (13.7 versus 9.4%, \( \chi^2 = 25.6, P < 0.0001 \)). Missing breakfast on the day of the study was no different between females and males in primary school in 2000 (9.6 versus 9.4%, \( \chi^2 = 0.03, \text{NS} \)) or in 2006 (6.0 versus 6.0%, \( \chi^2 = 0.00, \text{NS} \)) but it was more likely in females than males in Secondary school students in 2000 (27.7 versus 19.9%, \( \chi^2 = 17.8, P < 0.0001 \)) and in 2006 (18.7 versus 12.1%, \( \chi^2 = 20.1, P < 0.0001 \)).

The distribution of breakfast consumption on the actual day of the study by gender and school year in 2000 and 2006 as well as a comparison of actual consumption in 2000 and 2006 is given in Table II. Missing breakfast was significantly less frequent in 2006 than in 2000, respectively, among all students (12.7 versus 17.0%, \( \chi^2 = 35.12, P < 0.0001 \)) and was lower among males in 2006 versus 2000 (11.6 versus 15.3%, \( \chi^2 = 42.24, P < 0.0001 \)) and among females in 2006 versus 2000 (13.8 versus 18.9%, \( \chi^2 = 22.77, P < 0.0001 \)). There was a general trend toward more frequent consumption of breakfast and less breakfast skipping in 2006 compared with 2000 (12.7 versus 17.0%, \( \chi^2 = 35.12, P < 0.0001 \)) which can also be observed in almost all school year groups of males and females in Table II.

The distribution of breakfast consumption on the actual day of the study by gender and school SES in 2000 and 2006 is given in Table III; further, a comparison of actual consumption in 2000 and 2006 is also displayed in this table. There were significant SES differences in breakfast consumption in 2000 among males in low, middle and high SES schools, with more low and middle SES males missing breakfast compared with high SES males, respectively (18.5, 15.9 and 7.3%, \( \chi^2 = 16.3, P < 0.0001 \)). The same SES trends were also observed in males in 2006 (11.9, 9.8 and 5.6%, \( \chi^2 = 16.3, P < 0.0001 \)). There was a significant reduction in the number of low SES (\( P < 0.01 \)) and middle SES (\( P < 0.001 \)) males who missed breakfast in 2006 compared with 2000 (shown in Table III).

There were significant SES differences in breakfast consumption in 2000 among females in low, middle and high SES schools (Table III), with more low and middle SES females missing breakfast compared with high SES females, respectively (18.8, 22.1 and 6.4%, \( \chi^2 = 44.21, P < 0.0001 \)) and the same SES trends were also observed in females in 2006 (15.3, 14.8 and 10.0%, \( \chi^2 = 11.2, P < 0.01 \)). There was a significant reduction in the number of middle SES (\( P < 0.0001 \)) who missed breakfast in 2006 compared with 2000 (Table III).

**Nutritional quality of breakfast in 2000 and 2006 by gender and school SES**

The mean [standard deviation (SD)] nutritional quality of breakfast scores by gender and school
The nutritional quality of breakfast scores significantly improved in all year groups of males and among the majority of female school year groups, with the most significant improvements observed among the older year groups of females ($P < 0.0001$).

Improvement in the nutritional quality of breakfast was also observed in all school SES groups and among both males and females. These findings are presented in Table V.

The trend for low and middle school SES groups to consume a poorer nutritional quality of breakfast than high SES groups (Table V) was a statistically significant trend in both 2000 and 2006, despite the significant overall improvement in food group consumption within each school SES group during that time period. As shown in Table V, in 2000, the low school SES males consumed poorer nutritional quality of breakfast than the high school SES males after
applying an LSD post hoc test and controlling for age \((F = 22.21, P < 0.0001)\). In 2006, the same trend occurred with low and middle school SES males consuming a poorer nutritional quality of breakfast than the high school SES males \((F = 6.17, P < 0.001)\). In 2000, the low school SES females achieved lower nutritional quality of breakfast scores than the high school SES females after applying an LSD post hoc test and controlling for age \((F = 74.15, P < 0.0001)\) and the same trend remained statistically significant in 2006 with low school SES females achieving lower nutritional quality of breakfast scores than the high school SES females \((F = 33.61, P < 0.0001)\).

**Breakfast skipping and nutritional quality in 2000 and 2006 by combined overweight/obesity versus normal weight**

The prevalence of combined overweight/obesity was greater in 2006 than in 2000 with a prevalence of 21.6% overweight/obese and 78.4% normal weight in 2000 and 24.8 and 75.2%, respectively, in 2006 \((\chi^2 = 13.78, P < 0.0001)\).

Among all participants, overweight/obese participants were more likely than normal weight students to miss breakfast in 2000 (20.7 versus 16.0%, \(\chi^2 = 11.1, P < 0.01\)) and in 2006 (14.3 versus 10.4%, \(\chi^2 = 15.3, P < 0.0001\)).

Separate analyses by gender found that the number of overweight/obese male participants who missed breakfast on the day of the study was greater than the number of normal weight males who missed breakfast in 2000 (22.6 versus 13.2%, \(\chi^2 = 23.3, P < 0.0001\)) but the pattern was not present in 2006 (10.9 versus 9.1%, \(\chi^2 = 1.89, P = 0.19\)).

An analysis within each weight group by year (2000 versus 2006) found that breakfast skipping had declined in both overweight/obese and normal weight males and was greater in 2000 than in 2006 among overweight/obese males (22.6% in 2000, 10.9% in 2006, \(\chi^2 = 27.9, df = 1, P < 0.001\)). Breakfast skipping also declined among normal weight males in 2006 compared with 2000 (13.2% in 2000, 9.1% in 2006, \(\chi^2 = 15.40, P < 0.001\)).

The number of overweight/obese female participants who missed breakfast on the day of the study was no different than the number of normal weight females who missed breakfast in 2000 (18.9% in 2000 versus 18.7%, \(\chi^2 = 0.05, P < 0.95\)) but the pattern was different in 2006 with more overweight/obese than normal weight females skipping breakfast (17.6 versus 11.7%, \(\chi^2 = 16.3, P < 0.0001\)). Breakfast skipping was greater in 2000 than in 2006 among overweight/obese females compared with normal weight females, respectively (22.6% in 2000, 10.9% in 2006, \(\chi^2 = 27.9, P < 0.001\)) and breakfast skipping was also greater among normal weight males in 2000 than in 2006 (13.2% in 2000, 9.1% in 2006, \(\chi^2 = 15.40, P < 0.001\)).

Breakfast skipping and nutritional quality in 2000 and 2006 by combined overweight/obesity versus normal weight category in 2000 and 2006 is given in Table V. The nutritional quality of breakfast score improved significantly, after controlling for age, among both genders and all weight groups from 2000 to 2006.

**Discussion**

The aim of the current study was to examine the cross-sectional trends in breakfast consumption and nutritional quality between two nationally representative samples of schoolchildren in 2000 and 2006 after the concurrent implementation of several national breakfast promotion activities and a mass media television campaign. The study sought to specifically examine breakfast consumption and nutritional quality of breakfast by gender, school year group, school SES and weight status.

Significant improvement was found between both girls and boys in the 6-year cross-sectional assessment of breakfast consumption as well as a significant increase in the nutritional quality of breakfast. The improvements in breakfast consumption and quality from 2000 to 2006 were generally observed among both genders, virtually all age groups and among students from low, middle and high SES schools, as well as those who were overweight or obese. The consistency and strength of the results suggest that the trends in improvement of breakfast consumption were nationally representative and may be partially explained by the impact of the mass media advertisements [27] and the various school-based...
breakfast promotion activities that had been concurrently conducted during the same time period.

Despite the lack of a true control group, the study is the first to examine the impact of such large, coordinated, national breakfast promotion activities and is also the first to suggest improvement in the consumption of breakfast among children and adolescents, particularly girls, who have been notorious for skipping breakfast and resistant to nutrition education messages in past studies [30]. Our current findings also concur with previous research that confirmed that girls were less likely than boys to consume breakfast, that younger participants were more likely to have eaten breakfast [1–3, 14, 15] and that rates of breakfast consumption decrease throughout adolescence and into adulthood [30–32].

The findings of the current study suggest that breakfast skipping has decreased in recent years, with a current average of 6% of children and 15% of adolescents being regular breakfast skippers. These findings present a lower prevalence of breakfast skipping to recent international studies which report 20% of children and 31.5% of adolescents were breakfast skippers in 1999–2006 in the United States [14], 10–25% in European countries [17] and 8–26% in Australia [33]. The latter study is an interesting one with which to compare the current results as these are the most recent findings of the National Nutrition and Physical Activity Survey conducted by the Australian Government in 2007. The results of this large, nationally representative survey [33] report a substantially lower prevalence of breakfast skipping than the same national survey in 1995 which estimated that 10–35% of children and adolescents respectively were breakfast skippers [34, 35] but this prevalence is still higher than our current results. This finding suggests, on the one hand, that the national breakfast promotion activities and the television advertising campaign may have had a positive impact on the general population, but that the added health education activities at each individual school campus may have created an additional favorable impact for the 32 schools involved in the study. For example, breakfast skipping was reported at 13% of 9- to 12-year olds in the most recent analysis of the 2007 data from the National Nutrition and Physical Activity Survey [33] compared with 6.0% in the current intervention study. In addition, breakfast skipping was reported in 24% of 13- to 16-year olds in the recent national survey compared with only 16% in the current study. A possible explanation for this trend is that whilst the national sample from 2007 [33] was also impacted by the television advertising campaign [27], our national sample may have been additionally impacted by the individually focused breakfast promotion activities that had been targeted to each school via the principal, parents, teachers and students. The 32 schools in our intervention were exposed to the mass media campaign as well as receiving their individual school results and additional nutrition information and advice as part of a health promoting schools approach which focused heavily on breakfast promotion within the broader school community.

Another possible explanation for our findings, and one that has been previously suggested in the recent reviews [1, 2, 31], is that health promotion activities may have positive effect on breakfast skipping and academic performance by the increased school attendance that results from the programs. In other words, it is possible that some breakfast promotion programs actually encouraged children and teens to attend school by providing breakfast and they thereby inadvertently improve the breakfast skipping prevalence as a result. School attendance and the introduction of breakfast programs were not thoroughly documented in our current study, although some of the school principals reported that they responded to their school’s breakfast skipping results by promoting breakfast and providing breakfast at school programs. The provision of school breakfast programs is something that would be appropriate for future implementation in low SES schools which, despite significant improvement, still reported a concerning prevalence of breakfast skipping among students in our study.

The important role that parents have to play in this form of nutrition promotion activity has been noted [36] and we suggest the inclusion of parents...
and carers in any future breakfast promotion programs or school-based activities.

Further, we observed some improvement in breakfast skipping among obese and overweight young people in the current study, as breakfast skipping is known to be associated with obesity and an increase in weight over time [15–18], presumably in part because it is associated with snacking and overeating later in the day [16]. Further investigation of these results using a longitudinal study design may be important to clarify the role of breakfast consumption in the long-term development and prevention of childhood obesity, particularly among children from low SES backgrounds who currently appear to be at a combined risk of obesity and poor breakfast intake.

The strengths of the current study include the use of two large, nationally representative samples of children aged 7–18 years at the same 32 schools in 2000 and 2006, objectively assessed school SES, measured height and weight, accurate dietary information that was individually debriefed in a face-to-face interview with a dietitian, use of a validated breakfast instrument, adequate statistical power and a very good response rate in both survey years. Limitations include the lack of a true control group which precluded the implementation of an experimental study design. Future studies should build on our current findings by designing a controlled intervention that examines the impact of similar breakfast promotion activities. An important aspect to include in future studies would be to examine the impact of breakfast consumption upon body weight and the onset of childhood obesity in a longitudinal cohort of schoolchildren.

In conclusion, we report an increase in breakfast consumption among schoolchildren during the 6-year study period and suggest that the improvements may be explained by the impact of combined mass media and school-based breakfast promotion activities that were concurrently delivered during the same time period. We suggest the further exploration of such broad ranging combinations of health promotion strategies within a health-promoting school framework [37, 38] to maximize the adoption and impact of such interventions.

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### Conflict of interest statement

None declared.

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