



Investigating differences between traditional (paper bag) ordering and online ordering from primary school canteens: a cross-sectional study comparing menu, usage and lunch order characteristics

Alecia Leonard^{1,2,3,4}, Tessa Delaney^{1,2,3,4}, Kirsty Seward^{1,3,4}, Rachel Zoetemeyer^{1,2}, Hannah Lamont^{1,2}, Rachel Sutherland^{1,2,3,4}, Kathryn Reilly^{1,2,3,4}, Christophe Lecathelinais^{1,2,4} and Rebecca Wyse^{1,2,3,4,*}

¹School of Medicine and Public Health, University of Newcastle, Callaghan, New South Wales, Australia: ²Population Health Unit, Hunter New England Local Health District, Wallsend, New South Wales, Australia: ³Priority Research Centre – Health Behaviour, University of Newcastle, Callaghan, New South Wales, Australia: ⁴Hunter Medical Research Unit, Locked Bag 10, Wallsend, New South Wales 2287, Australia

Submitted 3 April 2020: Final revision received 7 August 2020: Accepted 24 August 2020: First published online 27 October 2020

Abstract

Objective: To assess differences between traditional paper bag ordering and online ordering from primary school canteens in terms of menu, usage and lunch order characteristics.

Design: A cross-sectional study.

Setting: New South Wales (NSW) primary schools that offered both paper bag and online canteen ordering.

Participants: Students (aged 5–12 years) with a lunch order on the day of the observation.

Results: Across the six school canteens, 59–90% of all available items were listed on both the online and paper menus, with no significant differences in the nutritional quality ('Everyday'/'Occasional') or nutritional content (kJ/saturated fat/sugar/sodium) of menu items. In total, 387 student lunch orders were placed, containing 776 menu items. Most orders (68%) were placed online. There were no significant differences between order modality in the quantity of items ordered or the cost of orders, or the nutritional quality of orders based on the classification system of the NSW Healthy School Canteen Strategy ('Everyday'/'Occasional'). However, nutritional analysis revealed that paper bag orders contained 222 fewer kJ than online orders ($P=0.001$), 0.65 g less saturated fat ($P=0.04$) and 4.7 g less sugar ($P<0.001$).

Conclusions: Online canteens are commonly used to order canteen lunches for primary school children. This is the first study to investigate differences between traditional paper bag ordering and online ordering in this setting. Given the rapid increase in the use of online ordering systems in schools and other food settings and their potential to deliver public health nutrition interventions, additional research is warranted to further investigate differences in ordering modalities.

Keywords
Children
School lunches
Canteen
Online ordering
Paper bag orders
Canteen site visits
Nutrition

Dietary risk factors are a leading cause of disease burden and are associated with increased risk of CVD, cancers and obesity⁽¹⁾. Evidence from large epidemiological nutrition surveys indicates that children overconsume foods high in fat, salt and sugar⁽²⁾. Given dietary behaviours in childhood persist into adulthood⁽³⁾, improving dietary behaviour in the early years may have the potential to

decrease health risks in the short- and long term⁽³⁾, and as such, represents a priority for public health^(4,5).

School food services such as cafeterias and canteens are key parts of the food environment for children⁽⁶⁾. They play an important role in shaping dietary patterns through: the foods that are made available and accessible to young people⁽⁷⁾; socialisation regarding food choices and decisions⁽⁸⁾

*Corresponding author: Email r.wyse@newcastle.edu.au

© The Author(s), 2020. Published by Cambridge University Press on behalf of The Nutrition Society



and reinforcing the nutrition curriculum content taught within classrooms. Canteens represent the most frequently accessed food provider for children, with 95 % of school children attending a school with a canteen and up to 55 % of students purchasing their lunch from canteens at least weekly⁽⁹⁾. Unhealthy purchases are common within the school canteen setting⁽¹⁰⁾.

Although the canteen ordering process may vary slightly from school to school, typically students' lunches are pre-ordered from the school canteen by the students themselves or by their parents and/or carers (hereafter referred to as parents) by writing the menu items they would like to purchase on a paper bag (along with their name and class). The cash payment is usually included in the paper bag with canteen managers either providing change as necessary or stipulating that exact change be provided. Students or parents are required to deliver the paper bag orders to the canteen by a pre-specified cut-off time each day (commonly the time at which school starts). Those writing the lunch order may or may not refer to a paper copy of the canteen menu depending on need and/or availability.

In line with a shift towards technological solutions and the growth of online purchasing more generally, the modality of ordering lunch in Australian schools has changed over the last decade. The use of online canteens, where students or parents go online to view, select and pay for menu items, is increasingly popular in Australian schools⁽¹¹⁾, and this online ordering is offered by a number of providers. The largest online canteen provider services over 1200 schools across Australia and processes over 13 million lunch orders annually⁽¹²⁾. Online canteens require users to log on via the web or a mobile application, access their school's latest menu and click on the menu items to add them to the basket. Users can review or amend their selections before placing the order. No cash is involved in the transaction; instead, payment is made via credit card or from an account balance held by the online canteen provider. Online orders can be placed using desktop or mobile devices and so can be made from anywhere and at any time prior to the set cut-off time. Additionally, recurring orders can be established, where a user places the same order for multiple occasions (e.g. each Friday for the entire school year).

There are many features of online canteens that make them an appealing delivery mechanism for public health nutrition interventions. They have wide reach (both in terms of the number of schools and individual users), they are frequently accessed and there is substantial existing infrastructure (e.g. software, hardware and technical support) which can be efficiently utilised to facilitate intervention delivery. Furthermore, they provide the opportunity to deliver interventions to users in real time at the point of purchase, a critical time point for influencing behaviour change⁽¹³⁾. As such, a number of trials have been and are currently being conducted in Australia and the USA, to try and establish whether interventions delivered via online

canteens can improve the nutritional quality of lunch orders purchased using these channels^(14–17).

Given the increase in popularity and uptake of online ordering systems and the potential to use them to deliver public health nutrition interventions, more information is needed regarding how people engage with these systems and how this might differ to traditional ways of purchasing school lunches. In order to determine the potential public health gain that could be achieved through intervention using these systems, it is important to determine if their use has introduced changes into this setting in terms of the availability of food, the volume and cost of food purchases and/or the nutritional value. Despite the widespread usage of these systems, to date, no studies have investigated potential differences in how people engage with them, or the changes in purchasing patterns that may arise due to their use.

Methods

Context

The *New South Wales (NSW) Healthy School Canteen Strategy* was revised in 2017. The revised strategy categorises food and drinks as 'Everyday' (which should comprise at least 75 % of the menu) and 'Occasional' (less healthy), with additional Health Star Rating and/or portion benchmarks for certain items⁽¹⁸⁾. The NSW Strategy also includes a 'Should Not Be Sold' (banned) category for items that do not comply with the above benchmarks as well as sugary drinks⁽¹⁸⁾. NSW Government schools were required to meet the revised *Healthy School Canteen Strategy* by December 2019⁽¹⁸⁾. Implementation of the NSW Strategy is also encouraged in NSW catholic and independent schools⁽¹⁸⁾.

This study assessed the differences between traditional paper bag ordering and online ordering from primary school canteens in terms of:

1. Menu characteristics:

- (a) *Item availability*: The proportion per school of all available canteen items that were listed on both the online and paper menu.
- (b) *Nutritional quality*: The proportion of items on online *v.* paper menus that were 'Everyday', 'Occasional' and 'Should Not Be Sold' according to the NSW *Healthy School Canteen Strategy*.
- (c) *Nutritional content*: The average energy (kJ), saturated fat (g), sugar (g) and Na (mg) content per item on online *v.* paper menus.

2. Usage characteristics:

- (a) The number and proportion of online *v.* paper bag lunch orders placed.



- (b) The number and proportion of online *v.* paper bag lunch orders for infants (grades K–2) *v.* primary students (grades 3–6).
- (c) The average number of items purchased in online *v.* paper bag lunch orders.
- (d) The average cost of online *v.* paper bag lunch orders.

3. Lunch order characteristics:

- (a) *Nutritional quality*: The proportion of items in online *v.* paper bag lunch orders that were 'Everyday', 'Occasional' and 'Should Not Be Sold' according to the *NSW Healthy School Canteen Strategy*.
- (b) *Nutritional content*: The average content of online *v.* paper bag lunch orders in terms of energy (kJ), saturated fat (g), sugar (g) and Na (mg).
- (c) *Proportion of substituted items*: The proportion of items purchased online *v.* via paper bag that were not supplied to students.

Design and setting

A cross-sectional study was undertaken in six primary schools (enrolling children aged 5–12 years) across NSW, Australia.

Sample and recruitment

Schools were selected from a sampling frame of thirteen control schools that were participating in a randomised controlled trial assessing the effectiveness of a behavioural intervention implemented via online canteens⁽¹⁶⁾. The sample was stratified by school sector. Sector refers to a group of educational institutions. In Australia, all schools fall into one of three sectors: government, catholic or independent. The stratification by sector was required due to differences in the implementation of the *NSW Healthy School Canteen Strategy*⁽¹⁹⁾, and given evidence suggesting there are differences in the relative availability of healthier items between sectors^(20,21). Within each sector, schools from the sampling frame were approached in a random order. A sample of six primary schools (three government, two catholic and one independent) were selected to participate in the study.

Eligibility

Schools were eligible to participate in this study if they: enrolled students aged 5–12 years; had a canteen onsite; processed paper bag and online lunch orders and had been randomly allocated to receive the control in the randomised controlled trial from which they were recruited. Eligibility criteria for the randomised controlled trial included NSW schools using an online canteen ordering system operated by the research partner provider. Combined schools enrolling both primary (kindergarten–grade 6) and secondary students (grades 7–12) were

included in the sample provided there was a separate online menu for the primary school (given differences in the *NSW Strategy* for primary and secondary schools) and a separate ordering period for primary school students, to enable isolation of primary school student purchases. Principal consent for this observational study was obtained when schools were recruited to the larger randomised controlled trial. The first six eligible schools to agree to a site visit date were included in this observational study.

Data collection and measures

On the day of each school visit, between two and four research assistants attended each school canteen depending on the number of canteen service lines, between the hours of 9 am–2:30 pm. All food and drink items that were purchased for students' lunches were recorded, including orders that were placed via the online ordering system and placed via paper bag.

Data collection protocols and tools

Observations were conducted by research assistants who were qualified dietitians, using data collection protocols previously utilised by the research team⁽²²⁾ and modified specifically for this study to include online lunch orders. Observations were recorded on a series of paper-based tools⁽²³⁾. The protocols and tools were piloted in one school prior to the collection of data from the six participating schools. All research assistants were trained during a 5 h workshop delivered by members of the research team (A.L., T.D. and R.Z.) who had experience in observational data collection in school canteen settings. The workshop involved several exercises including completion of data collection tools based on mock online and paper bag orders. Training incorporated a quality assurance component which required the research assistants to meet 100 % accuracy in recording student purchases using the data collection tools.

Online purchases: In each school, after the online order cut-off time, the canteen manager printed two lists of de-identified online orders from the online ordering software and provided them to the research team. The first list – the 'Production list' – summarised the total items ordered through the online system (e.g. eighty-six chicken nuggets, twelve sausage rolls, five strawberry milks and ten chocolate milks) and the second list – the 'Class list' – itemised the order for each individual student (e.g. student #xyz: six chicken nuggets, one strawberry milk). Using the 'Production list', the canteen manager identified any items they were unable to provide on the day (e.g. due to no available stock).

Paper bag purchases: The research assistants transcribed all paper bag orders onto a data collection tool ('Paper bag tally'). Student grade (e.g. kindergarten) was recorded next to details of the order, including item name, flavour and quantity. The cost of items purchased online was obtained from the online ordering system, and for



items purchased via paper bag, the cost was obtained from each school's current paper canteen menu.

1. Menu characteristics:

- (a) *Item availability*: Copies of the Term 2/Term 3 menus were collected from all schools. Both the online menu and the paper menu were collected for the same school term. Paper menus were either obtained from the school administrative assistant, from the canteen manager or from the school's website prior to the site visit. The online menu list was obtained through taking screenshots from within the online ordering app. The total number of menu items available (on either the online or paper menu) was calculated, and the proportion of those items that appeared on both menus was calculated. Prior to the site visit, a dietitian phoned the canteen manager to collect brand, product, flavour and serve size information for pre-packaged items and recipe and yield information for canteen-made items.
- (b) *Nutritional quality*: A dietitian classified each menu item according to the NSW Healthy School Canteen Strategy as 'Everyday', 'Occasional' or 'Should Not Be Sold'⁽¹⁸⁾. 'Everyday' items are those made from foods in the five food groups, 'Occasional' items are foods and drinks are mostly high in saturated fat, sugars and/or salt and often with little nutritional value and 'Should Not Be Sold' items represent the least healthy category and include sugary drinks, items that have a Health Star Rating of <3.5 and/or a portion size larger than the maximum size recommended within the Strategy⁽¹⁸⁾.
- (c) *Nutritional content*: For all pre-packaged items, the dietitian used a canteen product database containing over 2000 commonly sold canteen items (developed and maintained by the research team) to assign the nutritional profile per serve for each item (i.e. energy (kJ), saturated fat (g), sugar (g) and Na (mg)). Canteen-made recipes were entered into FoodWorks Version 9⁽²⁴⁾, a nutritional software program, to determine nutritional profile per serve, and then entered into the canteen product database.

2. Usage characteristics

Usage characteristics were collected from two sources. Information regarding use of the online lunch ordering system (i.e. number of orders, number of items ordered, order cost and grade of student) was automatically collected by the online ordering system. The canteen manager logged on to the online system and printed the 'Class list' and then provided a de-identified copy to the research assistant. Information regarding paper bag ordering was collected by research assistants using the 'Paper bag tally' data collection tool.

3. Lunch order characteristics:

- (a) *Nutritional quality*: The classification that the dietitian had previously assigned to each menu item (i.e. 'Everyday', 'Occasional' or 'Should Not Be Sold') was then applied to the purchased items, and the proportion of each classification was calculated for online and paper bag orders.
- (b) *Nutritional content*: Similarly, the nutritional profile that the dietitian had previously generated for each menu item (energy, saturated fat, sugar and Na content per item) was then applied to the purchased items, and the mean value per student lunch order was calculated for online and paper bag orders.
- (c) *Proportion of substituted items*: As the ordered lunches were packed into the bags for delivery to students, the research assistants verified that each item was packed as per the order, with the de-identified 'Class list' used to verify the online orders, and the 'Paper bag tally' used to verify the paper bag orders. The research assistants ticked off items as they were observed being placed into the bags, and a cross was placed above any items that were not packed. Details of any ordered items that were not packed were recorded, including item names, number of orders affected, reason not packed (e.g. out of stock, human error) and the substitution that was made (if applicable).

Data quality

The accuracy of the information in the canteen product database was verified by comparing each pre-packaged item observed on the day of the site visit against the item name, brand, flavour and serve size, collected during the telephone call with canteen managers.

School characteristics

Information regarding the characteristics of the participating schools was obtained via an online, freely available national school dataset, My School⁽²⁵⁾. The following information was collected: school sector (government, catholic and independent), school size (number of student enrolments), postcode and proportion of Aboriginal and Torres Strait Islander enrolments. School postcode was used to classify school socio-economic status using Socio-Economic Indexes for Areas⁽²⁶⁾ and rurality using the Accessibility/Remoteness Index of Australia⁽²⁷⁾.

Analysis

Data analysis was performed using SAS, version 9.3⁽²⁸⁾. School socio-economic status was dichotomised based on the median Socio-Economic Indexes for Areas value (high and low corresponded to above or below the median, respectively)⁽²⁶⁾. Generalised mixed models were used for all analyses and included a random effects intercept for schools to

control for potential clustering effects. Continuous outcomes (usage characteristics and nutritional content) were analysed using mixed linear regression models with separate models for each outcome. Nutritional content was calculated at an item level (for menu characteristics) and an order level (for lunch order characteristics) which could include multiple items (e.g. chicken burger, chocolate milk and apple). The proportion of items within online and paper bag ordering modalities that were 'Everyday', 'Occasional' and 'Should Not Be Sold' were analysed using logistic mixed models. Additional analyses on nutritional content and nutritional quality were conducted adjusting for school sector, Socio-Economic Indexes for Areas, Accessibility/Remoteness Index of Australia, student-grade level and the number of items purchased. Students in composite classes were included in the younger grade when adjusting for student grade, i.e. students in a grade 3/4 class were all included in grade 3. Differences in nutritional quality between ordered and substituted items were compared by using item energy content (kJ).

Results

Of the thirteen schools in the sampling frame, four were ineligible due to not having paper bag ordering (i.e. exclusively online orders), and an additional school was ineligible due to not having an onsite canteen. No schools declined to participate, and the first six schools who confirmed a date for the onsite visit were recruited to the study. School visits took place between May and June 2019. The sample included three governments, two catholic and one independent school. The characteristics of participating schools are described in Table 1.

1. Menu characteristics: comparison of online and paper menus

- Item availability:* The similarity of menus across ordering modalities varied between schools, with 59 to 90% of all items available at the schools being included on both menu formats. *Post hoc* comparisons of the online menu items *v.* the paper menu items determined similar composition in terms of food categories (e.g. fruit and vegetable items comprised 8.6 and 7.4% of online and paper menus, respectively) (no statistical testing was conducted).
- Nutritional quality:* There were no significant differences in the nutritional quality of the online *v.* paper menu ($\chi^2 = 0.87$), with the majority (68%) of items present on the online menu being 'Everyday' ($n = 348$), 17% 'Occasional' ($n = 87$) and 15% 'Should Not Be Sold' ($n = 78$). The paper menus contained 67% 'Everyday' items ($n = 346$), 18% 'Occasional' items ($n = 92$) and 6% 'Should Not Be Sold' items ($n = 75$).
- Nutritional content:* There were no significant differences in the average energy, saturated fat,

Table 1 Characteristics of participating schools and canteens

Characteristic	%	<i>n</i>
Average no. of children enrolled*		
Mean	478	
SD	196.1	
Average % of Aboriginal enrolments		
Mean	7.7	
SD	9.2	
Socio-economic region†		
Higher (socio-economically advantaged)	33	2
Lower (socio-economically disadvantaged)	67	4
Rurality‡		
Major cities	50	3
Inner regional	50	3
School sector		
Government	3	50
Non-Government	2	33
Catholic		
Independent	1	17
Canteen days of operation		
5 d per week	50	3
<5 d	50	3
Years using current online canteen provider	4.9	3.6

*Represents enrolment figures for five schools only. One combined school (kindergarten–grade 12) was excluded from this calculation as the number of primary students enrolled was not available.

†Based on Socio-Economic Indexes for Areas (SEIFA) 2016 (SEIFA is a categorisation developed by the Australian Bureau of Statistics that ranks Australian postcode locations according to relative socio-economic advantage and disadvantage. The indexes are publicly available from the Australian Bureau of Statistics and are based on information from the 5-yearly Census)⁽²⁶⁾.

‡Based on the Accessibility/Remoteness Index of Australia (ARIA) 2016⁽²⁷⁾.

sugar or Na content per menu item between online and paper bag menus, as shown in Table 2.

2. Usage characteristics:

During site visits, across the six schools, a total of 387 student lunch orders were placed, containing 776 items. More than two-thirds of orders (68%) were placed via the online ordering system. This varied between 57 and 87% across the six schools. Orders for infants students (kindergarten–grade 2) were significantly more likely to be placed using the online ordering system compared with orders for primary students (grade 3–grade 6) (OR = 2.12; $P = 0.002$), as shown in Table 3. There were no significant differences between online and paper bag orders in terms of the number of items ordered or the cost.

3. Lunch order characteristics:

- Nutritional quality:* There were no significant differences in the proportion of 'Everyday' ($P = 0.74$), 'Occasional' ($P = 0.62$) and 'Should Not Be Sold' ($P = 0.72$) items within online and paper bag orders, as shown in Table 4. Of the 547 online items ordered, 46% were 'Everyday' items, 41% were 'Occasional' items and 14% were 'Should Not Be Sold' items. Of the 229 paper bag items ordered, 46% were

Table 2 The average nutritional content of items appearing on paper and online menus

Mean nutritional content per menu item	Paper menu <i>n</i> 513		Online menu <i>n</i> 513		Mean difference	95 % CI	<i>P</i> -value
	Mean	SD	Mean	SD			
Energy (kJ)	743.86	535.90	725.18	521.63	-17.90	-102.79, 66.98	0.61
Saturated fat (g)	2.00	2.43	1.95	2.42	-0.04	-0.43, 0.35	0.81
Sugar (g)	8.93	9.26	8.98	9.31	-0.08	-1.56, 1.39	0.89
Na (mg)	271.34	317.32	263.23	309.49	-8.23	-58.40, 41.94	0.69

Table 3 Difference in usage characteristics between paper bag and online lunch orders

	Paper bag lunch orders		Online lunch orders		Effect size		<i>P</i> -value
	<i>n</i>	%	<i>n</i>	%	OR	CI 95 %	
Total usage (orders)	122	32	265	68 %			
Infants (K-2)	36	23	124	78 %	2.12	1.14, 3.95	0.002
Primary (3-6)	86	38	141	62 %			
Average # of items per order					0.13	-0.16, 0.41	0.31
Mean	1.88		2.02				
SD	0.99		1.01				
Average cost per order (AUD*)					0.38	-0.18, 0.94	0.14
Mean	5.17		5.38				
SD	1.69		2.13				

*Australian Dollar.

'Everyday', 41 % were 'Occasional' and 13 % were 'Should Not Be Sold' items.

- (b) *Nutritional content:* As shown in the adjusted analysis in Table 4, paper bag orders contained 222 kJ less energy than online orders ($P=0.001$), 0.65 g less saturated fat ($P=0.04$) and 4.7 g less sugar than online orders ($P<0.001$). There was no significant difference in the average Na content between online and paper bag orders ($P=0.10$).
- (c) *Item substitution:* Four students with reoccurring online orders were absent on the day, and as such 5 of the 765 ordered items were not packed. Of the remaining 760 ordered items, 98 % ($n=746$) were correctly packed into lunch bags. Of the fourteen items that were not packed into lunch bags, two items were out of stock and substituted for another item, ten items were not packed due to human error (no substitution made) and two items were out of stock and refunded by the canteen manager (i.e. no item was substituted). Of the two items substitutions, one contained 222 kJ less than the ordered item, the other contained 290 kJ more than the ordered item. Due to the low number of items substituted, no significance testing was carried out on item substitution.

Discussion

The modality of ordering lunch from Australian school canteens has changed over the last decade with the use of online

canteens becoming increasingly popular⁽¹¹⁾. To date, there have been no studies examining the implications of this change. This cross-sectional study observed differences between traditional (paper bag) ordering and online ordering from primary school canteens. Differences in the availability of items on the paper bag and online menu were compared and a disparity was found across all schools with only between 59 and 90 % of items found on both menu formats. In four of the six schools, there was a high degree of similarity between the paper and online menus (82-90 %), and the remaining two schools had 59 and 68 % similarity between menus. However, the nutritional quality (i.e. % of 'Everyday' items) and content (i.e. average energy, saturated fat, sugar and Na content per item) were similar between the paper bag *v.* online menus. The study found that, relative to grades 3-6 users, kindergarten-grade 2 users had a higher proportion of orders placed using the online systems. Furthermore, the kJ, saturated fat and sugar content of lunch orders placed via paper bag were significantly lower than orders placed online, despite the nutritional quality of orders being similar across ordering modalities (i.e. 'Everyday' foods comprised 46 % of foods ordered across both modalities).

This study reinforced the popularity of online canteen ordering with more than two-thirds of lunch orders being placed online. These results mirror trends in the broader online food market with growth rates of 22 % p.a. predicted for online grocery shopping over the next 5 years⁽²⁹⁾. In the current study, online lunch ordering was more common for infant students (kindergarten-grade 2) than for primary students (grades 3-6). This result may reflect the length of

Table 4 Differences between paper bag and online lunch orders

Nutritional quality labels*	Paper bag n 122 orders, 229 items		Online n 265 orders, 547 items		Unadjusted			Adjusted†		
	Mean	SD	Mean	SD	Mean difference (OR)	CI 95 %	Unadjusted P-value	Mean difference (OR)	CI 95 %	Adjusted P-value
% 'Everyday' items	46		46		OR: 1.13	0.81, 1.56	0.47	OR: 1.06	0.75, 1.49	0.74
% 'Occasional' items	41		41		OR: 0.95	0.69, 1.30	0.73	OR: 0.92	0.66, 1.28	0.62
% 'Should Not Be Sold' items	13		14		OR: 0.90	0.56, 1.46	0.68	OR: 1.10	0.66, 1.83	0.72
Average nutritional content‡										
Energy (kJ)	1551.69	636.70	1763.36	786.14	218.97	53.34, 384.60	0.010	221.50	86.62, 356.39	0.001
Saturated fat (g)	4.44	3.08	5.01	3.32	0.70	0.03, 1.37	0.041	0.65	0.02, 1.28	0.043
Sugar (g)	14.65	14.07	19.20	14.98	5.54	2.36, 8.72	<0.001	4.67	1.99, 7.36	<0.001
Na (mg)	605.93	342.39	669.22	368.01	48.61	-29.21, 126.43	0.22	64.30	-13.40; 142.00	0.10

*The denominator for the nutritional quality was all items ordered via that modality.

†The unit of analysis for the nutritional content (energy, saturated fat, sugar and Na) was the order level (which could consist of multiple items).

‡Analyses were adjusted for school sector, school SEIFA, school ARIA, student grade and number of items purchases. Analyses exclude five students whose grade could not be determined.

time that the relatively new technology has been available in schools. In the six schools, canteens had been using the online ordering system for an average of 4.9 years (SD 3.6 years) prior to the site visits. As such, online ordering was more likely to be available at the time the current infants students commenced school, compared with current primary students. Habit and previous experience are likely to contribute to this difference in usage rate by families with younger *v.* older students. The popularity of these online ordering systems, particularly for young children, highlights the potential for such systems to be used as a mechanism to deliver public health nutrition interventions with very wide reach. Results from a pilot study have been promising, indicating that interventions delivered through online ordering systems can substantially improve the healthiness of the foods ordered⁽¹⁴⁾.

Results from the current study indicate no significant difference in the average number of items, or the cost of orders between online and paper bag orders. It should be noted that all online orders incurred a service charge of AUD\$0.25 per order, and users were also subject to additional fees to top up their accounts. The calculation of the average cost of online lunch orders did not include these charges. However, given the majority of users opted to use the online system, these additional costs do not appear to be a substantial barrier to service use.

We were unable to locate studies investigating differences between different modalities for ordering food within the school setting, or studies from other settings that directly compared food orders that were hand-written *v.* placed online. However, differences in the appearance and usability of online menus and paper-based menus have previously been studied and may play a role in the

differences in nutritional content observed in the current study. A 2013 study in the restaurant setting by Beladonna *et al.* evaluated differences between e-tablet menus and traditional paper-based menus in terms of order information quality and ordering satisfaction⁽³⁰⁾. This observational study focused specifically on the information contained within the menu and found that online technology offered many more possibilities for menu enhancement (in terms of increased information quality, menu usability and ordering satisfaction) compared with paper-based menus. Authors likened the paper-based menu to an information brochure, whereas the e-tablet menu elicited more customer interaction, potentially encouraging a higher rate of purchase. Similarly, in the current study, there were differences in the layout of the paper *v.* online menu that may have influenced purchase behaviour through eliciting different consumer interaction. The online menus were more visually appealing: they included colourful images of foods; the greater space between items made it easier to read and the process of scrolling through the menu on a mobile device increased exposure to these features. Conversely, paper bag menus were largely black and white, had limited images and were generally more crowded with less space between menu items.

In addition, the location and environment in which the canteen order is placed may influence the content of the order. Approximately 70% of online orders are placed using a mobile device (as opposed to a desktop computer) which means that orders can be placed from anywhere there is an internet connection⁽¹⁶⁾. In comparison, paper bag ordering requires access to a paper bag and pen and also requires the user to have cash for payment. The online ordering system allows orders to be placed ahead



of time and allows recurring orders, whereas paper bag orders have to be placed on the day. Users of paper bag ordering may also rely on memory of the items available rather than physically accessing the paper menu, whereas it is not possible to place an order using the online ordering system without viewing at least some menu items. Furthermore, compared with items purchased online, the items written on the paper bag are more visible to other people (e.g. other students, other parents, teachers and canteen staff). The influence of social norms or pressure associated with the social desirability of food has been shown to affect parents' food choices for children⁽³¹⁾ and may affect purchasing within this sample. Online orders may be less likely to be influenced by similar social norms as they are somewhat 'anonymous' in the sense that the user is detached from the order itself, despite the child remaining visible to their peers and staff whilst eating their lunch.

These results may also be affected by the device used to access the online ordering system, with the majority of online orders placed using a mobile device (i.e. touchscreen) compared with a desktop computer (i.e. using a mouse)⁽¹⁶⁾. Several studies have examined the effect of ordering device (e.g. touch screen *v.* mouse) on purchasing behaviour in restaurants, retail and supermarket settings^(32–34). Multiple studies with university students have demonstrated that consumers using a touchscreen (compared to a mouse) were more likely to make hedonic rather than utilitarian purchases^(32,33). In 2016, Shen *et al.* conducted an experiment with 85 university students which revealed that the 'direct-touch' effect, where users feel as though they are reaching out and grabbing the item, led to more indulgent food choices when using a touchscreen to view and select different foods compared with a desktop computer⁽³²⁾.

Evidence from large population studies suggests a rapid increase in the use of online systems to order and access food. These systems are also now available in hospitals^(35,36), workplaces⁽³⁷⁾, schools^(14,16) and of course foods to be delivered to the home (e.g. take-away⁽³⁸⁾). By embedding health promotion strategies in routine systems⁽³⁹⁾, this process may provide an effective means of providing support to young people and families, with very high reach, with little to no time burden. This could improve purchasing habits and counter any trend towards less healthy purchasing. This research is showing promising results⁽¹⁶⁾.

Strengths of the study included representation from schools from all sectors (government, catholic and independent schools), from diverse geographical regions and higher and lower levels of advantage. Comprehensive data collection protocols were developed, and all research assistants were trained to a set standard and achieved high inter-rater reliability prior to commencing data collection. Furthermore, qualified dietitians experienced in the analysis of canteen menu items calculated the nutritional profiles for menu items based on

previously tested protocols and databases. We acknowledge the limitations of the study including being unable to examine the effects of individual user characteristics on purchasing behaviour, due to being unable to access this information. Also, despite the relatively large number of lunch orders placed, the small number of schools included is a limitation of the study. Despite all school sectors being represented, it is not clear the extent to which these results would generalise to other schools using online canteen ordering systems. Finally, the cross-sectional design means we were unable to draw any conclusions regarding causality relationships.

Future research in this area using larger sample sizes should investigate differences in the individual characteristics (including demographics, attitudes and beliefs) of users and differences in menu- and school-characteristics and the use of traditional *v.* online ordering. In addition, future research should investigate the relation between the percent of students ordering online and the percent of menu items listed online and how the uptake of online ordering varies by schools and students located in areas of disadvantage.

Conclusion

Online canteens are a popular ordering modality for parents of primary school children. This is the first study to investigate differences between traditional (paper bag) ordering and online ordering from primary school canteens. The study found that online ordering was the most prevalent form of ordering and that there were differences in usage between age groups. Results showed no differences in cost or quantity of items purchased, or in terms of the nutritional quality based on the classification system of the NSW Healthy School Canteen Strategy. However, it found lunch orders placed online had a higher energy, saturated fat and sugar content. The assessment of item substitution identified that the vast majority of canteen lunches are being provided to children as ordered. Given the rapid increase in the using of online ordering systems in schools and other food settings, additional research is warranted to further investigate differences in traditional and emerging food ordering modalities and to investigate opportunities for public health intervention using online ordering systems.

Acknowledgements

Acknowledgements: The authors wish to thank Flexischools, the Research Advisory Group and the participating schools and canteen managers. *Financial support:* This work is supported by The National Health and Medical Research

Council, grant number APP1120233. In-kind support is provided by Hunter New England Population Health and the Hunter Medical Research Institute. R.W. was supported by a Postdoctoral Fellowship (#102156) from the National Health Foundation of Australia. R.S. was supported by a TRIP Fellowship (APP1150661) from the NHMRC. *Conflict of interest:* None. The NHMRC has not had any role in the design of the study as outlined in this protocol and will not have a role in data collection, analysis of data, interpretation of data and dissemination of findings. The provider (Flexischools) was selected through a competitive tender process. Flexischools is a commercial organisation that provided the online canteen ordering infrastructure to schools that were included in the study. Flexischools had no role in the study design, data analysis, data interpretation or writing of the manuscript. *Authorship:* R.W. designed research; A.L. and T.D. developed the study protocol and tools; A.L., T.D. and R.Z. conducted research; C.L. analysed data; A.L. and R.W. wrote the paper and had primary responsibility for final content. All authors read and approved the final manuscript. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the ethics committees of the University of Newcastle (H-2017-0402), the New South Wales Department of Education and Communities (SERAP 2 018 065) and the Catholic Education Office Dioceses of Sydney, Parramatta, Lismore, Maitland-Newcastle, Bathurst, Canberra-Goulburn, Wollongong, Wagga Wagga and Wilcannia-Forbes. Written informed consent was obtained from all participating schools.

References

- Maynard M, Gunnell D, Emmett P *et al.* (2003) Fruit, vegetables, and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort. *J Epidemiol Community Health* **57**, 218–225.
- Australian Bureau of Statistics (2014) *Australian Health Survey: Nutrition First Results—Foods and Nutrients, 2011–12*. Canberra: Australian Bureau of Statistics.
- Mikkilä V, Räsänen L, Raitakari OT *et al.* (2004) Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: the cardiovascular risk in young finns study. *Eur J Clin Nutr* **58**, 1038–1045.
- World Health Organisation (2014) *Global Strategy on Diet, Physical Activity and Health*. Geneva: World Health Organisation.
- Department of Health and Ageing (2003) *Healthy Weight 2008 Australia's Future*. Canberra: Department of Health and Ageing.
- Bell AC & Swinburn BA (2004) What are the key food groups to target for preventing obesity and improving nutrition in schools? *Eur J Clin Nutr* **58**, 258–263.
- Ammerman AS, Lindquist CH, Lohr KN *et al.* (2002) The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Prev Med* **35**, 25–41.
- Golan M & Crow S (2004) Parents are key players in the prevention and treatment of weight-related problems. *Nutr Rev* **62**, 39–50.
- Hardy L, Mhrshahi S, Drayton B *et al.* (2017) *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2015: Full Report*. Sydney: NSW Department of Health.
- Delaney T, Sutherland R, Wyse R *et al.* (2019) A cross-sectional study of the nutritional quality of student canteen purchases from New South Wales primary-school canteens. *Public Health Nutr* **22**, 3092–3100.
- Wyse R, Yoong S, Dodds P *et al.* (2017) Online canteens: awareness, use, barriers to use, and the acceptability of potential online strategies to improve public health nutrition in primary schools. *Health Promot J Austr* **28**, 67–71.
- Delaney T, Wolfenden L, Yoong SL *et al.* (2018) A cluster randomized controlled trial of a consumer behavior intervention to improve healthy food purchases from online canteens. *Asia Pac J Clin Oncol* **14**, 13–14.
- Norman GJ, Zabinski MF, Adams MA *et al.* (2007) A review of eHealth interventions for physical activity and dietary behavior change. *Am J Prev Med* **33**, 336–345.
- Delaney T, Wyse R, Yoong SL *et al.* (2017) Cluster randomized controlled trial of a consumer behavior intervention to improve healthy food purchases from online canteens. *Am J Clin Nutr* **106**, 1311–1320.
- Miller GF, Gupta S, Kropp JD *et al.* (2016) The effects of pre-ordering and behavioral nudges on National School Lunch Program participants' food item selection. *J Econ Psychol* **55**, 4–16.
- Wyse R, Delaney T, Gibbins P *et al.* (2019) Cluster randomised controlled trial of an online intervention to improve healthy food purchases from primary school canteens: a study protocol of the 'click & crunch' trial. *BMJ Open* **9**, e030538.
- Wyse R, Gabrielyan G, Wolfenden L *et al.* (2019) Can changing the position of online menu items increase selection of fruit and vegetable snacks? A cluster randomized trial within an online canteen ordering system in Australian primary schools. *Am J Clin Nutr* **109**, 1422–1430.
- NSW Ministry of Health (2017) *The NSW Healthy School Canteen Strategy: Food and Drink Criteria*, 3rd ed. Sydney, NSW: NSW Ministry of Health.
- Reilly K, Nathan N, Wolfenden L *et al.* (2016) Validity of four measures in assessing school canteen menu compliance with state-based healthy canteen policy. *Health Promot J Aust* **27**, 215–221.
- Hills A, Nathan N, Robinson K *et al.* (2015) Improvement in primary school adherence to the NSW Healthy School Canteen Strategy in 2007 and 2010. *Health Promot J Austr* **26**, 89–92.
- Reilly KL, Nathan N, Wiggers J *et al.* (2018) Scale up of a multi-strategic intervention to increase implementation of a school healthy canteen policy: findings of an intervention trial. *BMC Public Health* **18**, 860.
- Wolfenden L, Nathan N, Janssen LM *et al.* (2017) Multi-strategic intervention to enhance implementation of healthy canteen policy: a randomised controlled trial. *Implement Sci* **12**, 6.
- Clinton-McHarg T, Janssen L, Delaney T *et al.* (2018) Availability of food and beverage items on school canteen menus and association with items purchased by children of primary-school age. *Public Health Nutr* **21**, 2907–2914.
- Xyris Software FoodWorks 9 Professional Xyris (2019). <https://xyris.com.au/whats-new-foodworks-9-professional/> (accessed September 2019).
- Australian Curriculum Assessment and Reporting Authority My School (2020). <https://www.myschool.edu.au/> (accessed June 2020).
- Commonwealth of Australia & Australian Bureau of Statistics (2018) Socio-economic indexes for areas (SEIFA) 2016.



- <https://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001> (accessed September 2019).
27. Hugo Centre for Migration and Population Research Accessibility/Remoteness Index of Australia (ARIA) (2020). <https://www.adelaide.edu.au/hugo-centre/services/aria> (accessed June 2020).
 28. SAS 9.3 Software Overview (2019). <http://support.sas.com/software/93/> (accessed September 2019).
 29. Online Grocery Sales – Australia Industry Research Reports IBISWorld (2020). <https://www.ibisworld.com.au/industry-trends/specialised-market-research-reports/online-retail/online-grocery-sales.html> (accessed October 2019).
 30. Beldona S, Buchanan N & Miller BL (2014) Exploring the promise of e-tablet restaurant menus. *Int J Contemp Hosp Manag* **26**, 367–382.
 31. Noble GI, Jones SC, McVie D *et al.* (2007) The paradoxical food buying behaviour of parents: insights from the UK and Australia. *Br Food J* **109**, 387–398.
 32. Shen H, Zhang M & Krishna A (2016) Computer interfaces and the “Direct-Touch” effect: Can iPads increase the choice of hedonic food? *J Mark Res* **53**, 745–758.
 33. Chung S, Kramer T & Wong EM (2018) Do touch interface users feel more engaged? The impact of input device type on online shoppers’ engagement, affect, and purchase decisions. *Psychol Mark* **35**, 795–806.
 34. Zhu Y & Meyer J (2017) Getting in touch with your thinking style: how touchscreens influence purchase. *J Retail Consum Serv* **38**, 51–58.
 35. NSW Ministry of Health Food and Patient Support Services (2020) *HealthShare*. <http://www.healthshare.nsw.gov.au/services/food-patient> (accessed July 2020).
 36. Roberts S, Hopper Z, Chaboyer W *et al.* (2020) Engaging hospitalised patients in their nutrition care using technology: development of the NUTRI-TEC intervention. *BMC Health Serv Res* **20**, 148.
 37. Hou J (2017) Can interface cues nudge modeling of food consumption? Experiments on a food-ordering website. *J Comput-Mediat Commun* **22**, 196–214.
 38. Keeble M, Adams J, Sacks G *et al.* (2020) Use of online food delivery services to order food prepared away-from-home and associated sociodemographic characteristics: a cross-sectional, multi-country analysis. *Int J Environ Res Public Health* **17**, 5190.
 39. Grady A, Yoong S, Sutherland R *et al.* (2018) Improving the public health impact of eHealth and mHealth interventions. *Aust N Z J Public Health* **42**, 118–119.