

Adoption of obesity prevention policies and practices by Australian primary schools: 2006 to 2013

N. Nathan^{1,2,3,4*}, L. Wolfenden^{2,3,4}, C. M. Williams^{2,3,4}, S. L. Yoong^{1,2,3,4},
C. Lecathelinais^{1,2}, A. C. Bell², R. Wyse^{2,3,4}, R. Sutherland^{1,2,3,4} and
J. Wiggers^{1,2,3,4}

¹Hunter New England Population Health, Hunter New England Area Health Service, Newcastle, Locked Bag No. 10, Wallsend, NSW 2287, Australia, ²School of Medicine and Public Health, The University of Newcastle, Newcastle, NSW 2308, Australia, ³Priority Research Centre for Health Behaviour, The University of Newcastle, Newcastle, NSW 2308, Australia and ⁴Hunter Medical Research Institute, Newcastle, NSW 2300, Australia

*Correspondence to: N. Nathan. E-mail: Nicole.Nathan@hnehealth.nsw.gov.au

Received on April 15, 2014; accepted on November 12, 2014

Abstract

Despite significant investment in many countries, the extent of schools' adoption of obesity prevention policies and practices has not been widely reported. The aims of this article are to describe Australian schools' adoption of healthy eating and physical activity policies and practices over an 8-year period and to determine if their adoption varies according to schools' size, geographic or socio-economic location. Between 2006 and 2013, a representative randomly selected cohort of primary schools ($n = 476$) in New South Wales, Australia, participated in four telephone interviews. Repeated measures logistic regression analyses using a Generalised Estimating Equation (GEE) framework were undertaken to assess change over time. The prevalence of all four of the healthy eating practices and one physical activity practice significantly increased, while the prevalence of one physical activity practice significantly decreased. The adoption of practices did not differ by school characteristics. Government investment can equitably enhance school adoption of some obesity prevention policies and practices on a jurisdiction-wide basis. Additional and/or different implementation strategies may be required to facilitate greater adoption of physical activity practices. Ongoing monitoring of school adoption of school policies

and practices is needed to ensure the intended benefits of government investment are achieved.

Introduction

In 2004, based upon the International Obesity Taskforce criteria, it was estimated that ~10% of children aged 5–17 years were overweight and that up to 3% were obese [1]. In Australia in 2007–08, up to 25% of Australian children aged 5–17 years were overweight or obese, with 7.5% classified as obese [2]. The environments in which children live have been recognized as important determinants of excessive weight gain [3]. Schools represent one such environment that is considered to be particularly influential in shaping the dietary and physical activity behaviours of children given the almost universal attendance of children in schools [4] and the impact of schooling on child development [5]. Schools can influence children's diet and physical activity through curriculum content; modifying the school physical and policy environment and through engagement with parents and the broader community [6–8].

Given these opportunities, governments internationally have invested in policy and program initiatives to facilitate school promotion of healthy diets and physical activity. For example, in the United States, the Centres for Disease Control and

Prevention support state school education agencies to promote healthy eating and physical activity through the development of school wellness policies; provision of quality school meal programmes; restriction on the sale of competitive foods and implementation of quality physical activity programmes [9]. The United Kingdom has similarly introduced food-based standards for school lunches and vending machines; a school fruit and vegetable scheme and a competitive school sport programme [10]. In Australia, a variety of school obesity prevention initiatives have been implemented including mandatory healthy school canteen guidelines; professional development programmes for teachers and curriculum-based programmes [11].

Although cross-sectional and pre-post studies of the prevalence of obesity prevention policies and practices in schools have reported improved, but continuing sub-optimal rates of adoption of such policies and practices [12–16], very few studies have reported the adoption and sustainability of such adoption over an extended period of time [17]. As a consequence, understanding of the impact of investment in this area is constrained, limiting the ability to determine if such investment is sufficient and/or appropriately targeted and whether observed improvements are sustained or require remedial strategies [17]. In the United States, the School Health Policies and Practices Study has conducted repeat cross-sectional computer assisted interviews of randomly selected primary and high schools every 6 years since 1994. The surveys address a range of school health issues, including nutrition and physical education services [18]. The most recent 2012 study reported that between 2000 and 2012, the proportion of school districts that prohibited the sale of ‘junk foods’ from school vending machines increased from 4.1 to 43.4% [14], the proportion that taught physical education increased from 82.6 to 93.6% [19] and the proportion that allowed the sale of soft drinks decreased from 80.4 to 60.3% [14]. Although such findings suggest that the food environment of US schools is improving, the finding that less than half of school districts prohibited the sale of ‘junk’ foods has led to changes in

the minimum nutrition standards regarding the sale of foods outside the school meal program [20].

In Australia, limited evaluation of the adoption of healthy eating and physical activity policies and practices by schools over time has been reported. In the state of New South Wales, the Schools Physical Activity and Nutrition Survey has involved a survey of randomly selected cross sectional samples of schools in 1997, 2004 and 2010. School Principals were asked to complete a questionnaire on their schools’ physical activity facilities equipment and personnel, time allocated to physical education and sport and general strategies to promote physical activity participation [21]. Limited data regarding trends in such measures were provided, with general findings suggesting no change or slight increases in prevalence between 1997 and 2010 [21]. In the absence of information regarding the prevalence of school adoption of both healthy eating and physical activity practices over time, a longitudinal study was conducted to describe the adoption by schools of such practices and to determine if their adoption varied according to the size, geographic or socio-economic location of schools.

Methods

Ethics approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures were approved by the Hunter New England Area Health Service Human Research Ethics Committee (no. 06/07/26/4.04), the NSW Department of Education and Communities and relevant Catholic Schools Offices. Verbal informed consent was obtained from all subjects and formally recorded.

Design and setting

A longitudinal study of a cohort of primary and central schools was conducted over an 8-year period in the state of New South Wales, Australia. The state has a population of ~887,086 children aged between 5 and 14 years (Centre for Epidemiology and

Evidence, NSW Ministry of Health) and over 2200 schools catering for children 5–12 years of age.

Over the past decade, a number of international, national and state policy initiatives have facilitated the adoption of obesity prevention policies and practices by schools in the state: These included, for example, the World Health Organizations' global strategy on diet, physical activity and health (2001) [22]; Australian National obesity action plan (2008); New South Wales Child Obesity Summit (2002) [23] and the New South Wales obesity prevention plan (2009) [24]. As a consequence, a number of specific state level mandatory policies and recommended programmes targeting the school environment have been published [25]. This study attempts to measure some of these such as; a mandatory policy for Government schools regarding the amount of planned physical activity in the school physical education curriculum (1998) [26]; the mandatory teaching of nutrition education through the Personal Development, Health and Physical Education (PDHPE) syllabus (1999) [23]; a mandatory healthy school canteen policy (2005) [27]; a recommended school fruit and vegetable program (2007) [28] and recommended physically active playgrounds (2008) [25]. To support schools' adoption of these policies and programmes, the state made available professional learning programmes and resources for teachers regarding nutrition and physical education (2008) [29] and enhanced funding for implementation of such programmes (2011) [30].

Sample

A database of all Government and non-Government (Catholic and Independent) primary (children 5–12 years of age) and central (children 5–18 years of age) schools was generated from school lists provided on websites of the Department of Education and Communities [31], the Catholic Education Commission [32] and the Association of Independent schools [33]. Special purpose schools (such as those for students with special needs, juvenile justice or schools serving children who are hospitalized) were excluded. A cohort of 476 eligible schools (~22%) was randomly selected in

2006 and contacted on four occasions over an 8-year period: 2006, 2008, 2010 and 2013.

Recruitment and data collection

At each time point, the same methods were used, with Principals of all originally selected schools were sent an information letter inviting them or a nominated delegate (hereinafter referred to as Principals) to participate in a 25-min Computer-Assisted Telephone Interview survey. Two weeks following mailing of the invitation, research assistants telephoned each school Principal to confirm school eligibility and to gain participant consent. The surveys were conducted over the spring and summer of each year. Principals from central schools were asked to report on activities relevant to primary school age classes (5–12 years) only.

Measures

School characteristics

During the telephone interview, Principals were asked to report the number of students attending the school. School type (Government, non-Government Catholic or non-Government independent) and the postcode of the locality of each school were obtained from school websites.

Obesity prevention policies and practices

The survey at each time point included the following items addressing the three domains of the Health Promoting Schools Framework: curriculum, ethos and environment and community [8]. The content of the items were based on state guidelines [26, 29] or recommended programmes [28, 29]. Where available, validated survey items were used [34]. Principals were asked to report on the following four healthy eating and five physical activity practices:

- Incorporation of teaching healthy eating in key learning areas other than physical education (yes/no/don't know).
- Teaching of physical activity in key learning areas other than physical education (yes/no/don't know).

- Teaching of fundamental movement skills (FMS) in the physical education program.
- Written healthy eating and nutrition policy (yes/no/don't know).
- Written physical activity plan or policy (yes/no/don't know).
- Existence of vegetable and fruit breaks in class ('yes all classes', 'yes some classes', 'no classes', 'don't know').
- Existence of school playground markings for games and availability of sports equipment for student use (yes recess only/yes lunch only/yes recess and lunch/no/don't know) (not asked in 2008).
- School provision in past 12 months of information to parents/carers about healthy eating (yes/no/don't know).
- School provision in the past 12 months of information to parents/carers about physical activity (yes/no/don't know).

Analyses

All analyses were conducted using SAS Version 9.3 (SAS Institute Inc., Cary, NC). The number of students in each school was used to categorize schools as 'small schools' (1–159 students); 'medium schools' (160–450 students) or 'large schools' (451+ students). Schools with post-codes ranked in the top 50% of state post-codes based on Socio-Economic Indexes for Australia (SEIFA) [35] were categorized as schools in 'higher socio-economic areas', whereas those in the lower 50% were categorized as schools in 'lower socio-economic areas'. School post-code areas were also used to categorize the school's locality as either 'rural' (those schools in outer regional, remote and very remote areas) or 'urban' (those in regional cities and inner regional areas) based upon the Accessibility/Remoteness Index of Australia [36]. The prevalence of each of the healthy eating and physical activity policies and practices was calculated as the proportion of schools that reported 'yes' (implementing). The prevalence of vegetable and fruit breaks within schools was calculated as the proportion of Principals reporting

that 'all or some' classes had such a break. The prevalence of playground markings and sports equipment was calculated as the proportion of Principals that reported that sports equipment and playground markings (for both infants and primary students) were available at both recess and lunch. Analysis was performed to determine the proportion of schools implementing each practice at each time point and to determine the proportion of schools adopting: 80% and 100% of healthy eating practices, 80% and 100% of physical activity practices and 80% and 100% of all healthy eating and physical activity practices at each time point.

Repeated measures logistic regression analyses using a GEE framework were undertaken to assess whether there was a significant change in the prevalence of each outcome measure between 2006 and 2013 adjusting for prevalence in the intervening years. These same models were used to determine whether there had been a change in trend of adoption during the period between these two time points, regardless of whether there was a difference in prevalence between the two time points. To examine whether there was a differential change in adoption between 2006 and 2013 based on school characteristics, for each outcome three additional models were developed which included a time by rurality interaction term, a time by socio-economic status interaction term and a time by school size interaction term.

Results

Sample and school characteristics

The proportions of the original sample of eligible schools that completed the survey at each time point were 84.0% (2006), 83.2% (2008), 68.7% (2010) and 63.7% (2013) (Table I). Overall, 193 (40.6%) schools completed all four surveys and 333 (70.0%) completed three or more surveys. Although there was no significant difference in school participation, based on school characteristic, at each individual time point, small, Government, rural, low-socio-economic schools and schools that were

Table I. *Characteristics of participating schools*

School characteristics	<i>n (%)</i>			
	2006 (<i>N</i> = 400)	2008 (<i>N</i> = 396)	2010 (<i>N</i> = 327)	2013 (<i>N</i> = 303)
School type				
Government	298 (74.5)	294 (74.2)	247 (75.5)	239 (78.9)
Non-Government	102 (25.5)	102 (25.8)	80 (25.5)	64 (21.1)
School size				
Small	153 (38.3)	148 (37.4)	122 (37.3)	114 (38.4)
Medium	169 (42.2)	183 (46.2)	147 (45.0)	133 (44.8)
Large	78 (19.5)	65 (16.4)	58 (17.7)	50 (16.8)
Accessibility/Remoteness Index of Australia				
Rural	106 (26.5)	107 (27.0)	89 (27.2)	93 (31.0)
Urban	294 (73.5)	289 (73.0)	238 (72.8)	205 (69.0)
SEIFA				
Low SES	241 (60.2)	234 (59.1)	198 (60.6)	190 (64.0)
High SES	159 (39.8)	162 (40.9)	129 (39.4)	107 (36.0)

implementing 80% or more of both healthy eating and physical activity practices in 2006 were more likely to complete three or more surveys.

Change in prevalence of adoption between 2006 and 2013

Based upon the responses of the consenting schools at each time point, there were significant increases in the prevalence of five of the nine practices and a significant decrease in the prevalence of one practice between 2006 and 2013. A significant change in trend of adoption was found in eight of the nine practices (Table II). The proportion of schools adopting at least 80% of all nine practices (six or more) increased from 31.7% in 2006 to 50.5% in 2013. The prevalence and trend of adoption for all four of the healthy eating practices significantly increased between 2006 and 2013 (range of absolute increases 9.1–11.4%) as did the proportion of schools adopting at least 80% of such practices (three practices) (2006: 41.9%; 2013: 73.5%). The prevalence of one of the five physical activity practices significantly increased (2006: 52.3%; 2013: 70.2%) and for one, significantly decreased (2006: 88.4%; 2013: 81.5%). In contrast, a significant change in trend of adoption was found for four of

the five practices. There was a significant increase in the proportion of schools adopting 80% of the physical activity practices from 45.1% in 2006 to 53.1% in 2013. The prevalence of adoption of practices did not significantly differ by school characteristics.

Discussion

This study sought to describe changes in the adoption of healthy eating and physical activity policies and practices by a cohort of Australian primary schools between 2006 and 2013. Significant improvements in some aspects of the obesity prevention environment of schools were observed over this period, with almost 51% of schools implementing 80% or more of the nine policies and practices in 2013, a marked increase from the 31.7% observed in 2006. This improvement was primarily due to significant increases in adoption of healthy eating practices over this period. In contrast, there was a significant decrease in the proportion of schools adopting one of the five physical activity policies and practices (88.4–81.5%) and a significant increase in the adoption of only one such practice. No differences were found in the adoption of policies and practices according to school size, location

Table II. Prevalence of healthy eating and physical activity policies and practices adopted by Australian schools 2006–2013

Healthy eating and physical activity policies and practices of schools	2006 (N = 400), n (%)	2008 (N = 396), n (%)	2010 (N = 327), n (%)	2013 (N = 303), n (%)	Change between 2006 and 2013, P value [OR (95% CI)]	Change in trend (2006–2013), P value
School healthy eating practices						
Has a policy which supports healthy eating	104 (26.0)	110 (27.8)	153 (46.8)	116 (38.9) ^a	0.0003* [1.78 (1.30–2.43)]	<0.0001*
Integrates the teaching of healthy eating into other subjects.	259 (65.1) ^a	273 (68.9)	241 (73.7)	221 (72.9)	0.03* [1.41 (1.04–1.91)]	0.04*
Has a vegetable and fruit break	170 (42.6) ^a	249 (62.9)	253 (77.4)	268 (88.5)	<0.0001* [9.39 (6.61–13.34)]	<0.0001*
Promotes healthy eating to students and their families	335 (89.4) ^a	320 (80.8)	242 (74.0)	291 (96.0)	0.002* [2.87 (1.47–5.60)]	<0.0001*
% of schools adopting at least 80% of healthy eating practices	165 (41.9)	202 (51.0)	203 (62.1)	219 (73.5)	<0.0001* [3.63 (2.70–4.86)]	<0.0001*
% of schools adopting 100% of healthy eating practices	34 (8.6)	51 (12.9)	85 (26.0)	87 (29.2)	<0.0001* [4.28 (2.79–6.57)]	<0.0001*
School physical activity practices						
Has a policy which supports physical activity	192 (48.0)	221 (55.8)	223 (68.2)	151 (49.8)	0.65 [1.07 (0.81–1.41)]	<0.0001*
Integrates the teaching of physical education across other subjects.	216 (54.3) ^a	255 (64.4)	229 (70.0)	180 (59.4)	0.19 [1.22 (0.90–1.65)]	<0.0001*
Teaches fundamental movement skills (FMS)	337 (84.3)	333 (84.1)	285 (87.2)	262 (86.5)	0.37 [1.22 (0.79–1.87)]	0.44
Has playground markings and sports equipment available for student use at recess and lunch	209 (52.3)	219 (67.0)	219 (67.0)	212 (70.2) ^a	<0.0001* [2.08 (1.57–2.75)]	<0.0001*
Promotes physical activity to students and their families	351 (88.4) ^a	258 (65.2)	220 (67.3)	247 (81.5)	0.010* [0.59 (0.39–0.88)]	<0.0001*
% of schools adopting at least 80% of physical activity practices	178 (45.1)	242 (61.1)	190 (58.1)	161 (53.1)	0.03* [1.38 (1.04–1.84)]	<0.0001*
% of schools adopting 100% of physical activity practices	51 (12.9)	100 (25.3)	79 (24.2)	58 (19.2)	0.02* [1.59 (1.07–2.36)]	<0.0001*
% of schools adopting at least 80% of ALL healthy eating and physical activity practices	125 (31.7)	188 (47.5)	170 (52.0)	150 (50.5)	<0.0001* [2.11 (1.58–2.82)]	<0.0001*
% of schools adopting 100% of ALL healthy eating and physical activity practices	7 (1.8)	23 (5.8)	63 (19.3)	31 (10.4)	<0.0001* [6.32 (2.78–14.38)]	<0.0001*

^aSample size varies due to missing data.

*Significant at 0.05 level.

or socio-economic status. Such findings suggest that school adoption of some obesity prevention policies and practices can be equitably improved. However, continued implementation of existing strategies or the implementation of additional and/or different strategies is required if all primary school children are to obtain the intended benefits of government investment in this area and to ensure that children receive benefits from the promotion of physical activity.

The observed increase in the proportion of schools adopting each healthy eating practice between 2006 and 2013 ranged from 6.6 to 45.9%, a scale of improvement consistent with research conducted in the United States between 2006 and 2012 where improvements in school adoption of healthy eating practices have ranged from 5.0 to 39.3% [14] and previous shorter term studies in Australia [37]. The largest increase in school adoption found in this study involved the implementation of a vegetable and fruit break, which increased from 42.6% in 2006 to 88.5% in 2013. Implementation of school vegetable and fruit programmes has been recommended by the Commonwealth Government of Australia since 2005 [38], with their implementation in New South Wales schools being supported by training, teaching resources, promotional materials and follow-up support by local health promotion staff since 2007 [28]. With almost 90% of schools in New South Wales implementing a vegetable and fruit break in 2013, such findings demonstrate a successful model of implementation and suggest a possible need for strategies that have a focus on improving the sustainability of program adoption. For example, in 2013, only 38.9% of schools reported having a written healthy nutrition policy in place.

In contrast to such findings, and to findings in the United States [19] and New South Wales [21], limited improvement was observed in school adoption of practices promoting physical activity between 2006 and 2013. Over this period, the prevalence of only one practice, the provision of playground markings, significantly increased (52.3–70.2%). The adoption of two practices, having a physical activity policy and teaching of physical education in classes

other than physical education, increased between 2006 and 2010 but declined to approximately 2006 levels in 2013, suggesting a lack of sustainability of gains initially achieved. Furthermore, between 2006 and 2013, there was no significant improvement in the proportion of schools that reported teaching fundamental movement skills, a mandatory component of the physical education curriculum.

Such a finding is, however, consistent with other studies regarding the teaching of physical education in Australian schools. For example, in 2012, the NSW Auditor-General undertook a review into physical activity in NSW Government Primary Schools [16], finding that 30% of primary schools were not meeting the required 2 h of planned physical activity each week; many schools did not have a Physical Education (PE) policy and schools had highly sedentary PE lessons that did not sufficiently focus on fundamental movement skill development. Similarly, although limited data regarding trends over time were available from the 2010 New South Wales schools physical activity and nutrition survey, the general findings of that survey of no change or slight increase in prevalence of practices promoting physical activity between 1997 and 2010 appear to be supported by the findings of this study [21].

Previous studies have found that teachers report a number of barriers to the teaching of physical education, including a lack of skills and confidence; training; time; interest; support and resources [16, 39–41]. To address such barriers, since 2008, schools across the state have had access to a professional development program that supports the implementation of ‘whole of school’ obesity prevention initiatives through the provision of training workshops for two teachers per school, funding (\$2000), teaching resources and local support. Through the development of school action plans following the workshops, the program seeks to increase the teaching of both nutrition and physical activity in the classroom and to aid the development of related school policies and community links [29]. The program does not specify the implementation of any specific strategy or initiative to promote physical education teaching, with strategy selection being at the discretion of each school.

The finding of limited adoption of practices promoting physical activity suggests a need to enhance or add to existing program implementation strategies if schools are to effectively promote physical activity generally and to increase the teaching of physical activity specifically. A number of studies suggest that a comprehensive approach to school capacity building, including professional development for all teachers, can be effective in achieving such outcomes [42, 43]. For example, in the United States, the Sports, Play and Active Recreation for Kids (SPARK) physical activity program provides a specific physical activity curriculum program, on-site staff development for all teachers, teaching resources, equipment and extensive follow-up support. Evaluation of the program found that 4 years post intervention, up to 80% of schools reported sustained use of the program and were significantly more likely to run three or more physical education classes per week than schools not participating in the program [44].

Given the link between obesity and socio-economic disadvantage, it is important that obesity prevention initiatives do not have more favourable outcomes in advantaged schools than in disadvantaged schools [45]. The finding of this study that the adoption of physical activity practices over time and the overall prevalence of practices in 2013 did not vary between schools according to their geographic and socio-economic location suggests that the strategies utilized for supporting school adoption of both healthy eating and physical activity practices have not further exacerbated existing differentials between more and less advantaged populations. Given small, Government, rural and low-socio-economic schools were more likely to complete three or more surveys, these results may need to be interpreted with some caution.

A number of study characteristics need to be considered when interpreting the study findings. Firstly, although two of the survey items have been validated, questions relating to school policies and the teaching and promotion of healthy eating and physical activity have not. In addition, although there were no differences between consenting and non-consenting schools (based upon school

characteristic) at each individual time point, schools who implement obesity prevention policies and practices may be more likely to participate in such a study. Therefore, the observed prevalence of these practices may be an overestimate. If this was the case, the conclusion regarding the need for additional or enhanced strategies is strengthened. Secondly, repeated data collection from the same schools could potentially result in a reporting bias whereby respondents over report their school practices, thereby exaggerating the prevalence findings at each time point. Third, although the study found no significant differences for disadvantaged schools, this was based upon the use of postcode and SEIFA. At a population level, SEIFA is useful as it represents the general socio-economic status of the area in which individuals live; however, it may not accurately represent the socio-economic status of students attending a particular school given students may attend a school outside of the area that they reside. Fourth, the study assessed a limited number of policies and practices that schools could adopt to promote healthy eating and physical activity. The potential exists for schools to have adopted other practices with such an objective. As new evidence and policy developments have occurred since the initial survey, further surveys should consider the inclusion of a broader range of practices. Similarly, as the survey did not systematically assess the quality of policy and practice adoption, the extent to which the intended benefits for children are likely to be realized is unknown. Future surveys would be enhanced by the inclusion of additional items that assess the fidelity of implementation.

Conclusion

The findings of this study suggest that although government policies and investment have improved the healthy eating environments of schools, additional and/or different dissemination strategies may be required to facilitate greater adoption of policies and practice related to increased physical activity. The study demonstrates the benefit of regular monitoring of school adoption of policies and practices as

a means of identifying the impact of existing policies and investment and the need for such policies to be refined, expanded or better targeted.

Acknowledgements

The authors wish to thank the survey respondents of participating schools.

Funding

This work was supported by the NSW Health ASSIST program. The project also received infrastructure support from the Hunter Medical Research Institute (HMRI) and Hunter New England Population Health.

Conflict of interest statement

None declared.

References

1. International Obesity Taskforce. *Obesity the Global Epidemic*, 2013. Available at: <http://www.iaso.org/iotf/obesity/obesitytheglobalepidemic/>. Accessed: 19 September 2014.
2. Australian Bureau of Statistics. *Health—Obesity*, 2008. Available at: [http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/bySubject/1370.0~2010~Chapter~Obesity \(4.1.6.6.3\)](http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/bySubject/1370.0~2010~Chapter~Obesity (4.1.6.6.3)). Accessed: 19 September 2014.
3. Doak CM, Visscher TL, Renders CM *et al*. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obes Rev* 2006; **7**: 111–36.
4. Carter RC. The impact of public schools on childhood obesity. *J Am Med Assoc* 2002; **288**: 2176–82.
5. Story M, Nannery MS, Schwartz MB. Schools and obesity prevention: creating school environments and policies to promote healthy eating and physical activity. *Milbank Q* 2009; **87**: 71–100.
6. Centers for Disease Control and Prevention. Guidelines for school health programs to promote lifelong healthy eating. *J School Health* 1997; **67**: 9–26.
7. Centers for Disease Control and Prevention. School Health Guidelines to Promote Healthy Eating and Physical Activity. *MMWR* 2011; **60**(No. RR-5): 1–74.
8. Lister-Sharp D, Chapman S, Stewart-Brown S *et al*. Health promoting schools and health promotion in schools: two systematic reviews. *Health Technol Assess* 1999; **3**: 1–207.
9. US Institute of Medicine. Schools. In: Koplan JP, Liverman CT, Kraak VI (eds). *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: National Academies Press, 2005, 237–84.
10. National Audit Office. *An Update on the Government's Approach to Tackling Obesity*. London: Department of Health, 2012. Available at: http://www.nao.org.uk/wp-content/uploads/2012/07/tackling_obesity_update.pdf. Accessed: 2 December 2014.
11. Crowle J, Turner E. *Childhood Obesity: An Economic Perspective, Productivity Commission Staff Working Paper*, Melbourne, 2010.
12. Nathan N, Wolfenden L, Butler M *et al*. Vegetable and fruit breaks in Australian primary schools: prevalence, attitudes, barriers and implementation strategies. *Health Educ Res* 2011; **76**: 722–31.
13. Bere E, Veierbd MB, Klepp K-I. The Norwegian School Fruit Programme: evaluating paid vs. no-cost subscriptions. *Prev Med* 2005; **41**: 463–70.
14. Merlo CL, Harris DM, Lane KG. Nutrition services and the school nutrition environment: results from the CDC school health policies and practices study 2012. *Chapter in School Health Policies and Practices Study*. Atlanta: CDC, 2012, 75–89.
15. de Silva-Sanigorski A, Breheny T, Jones L *et al*. Government food service policies and guidelines do not create healthy school canteens. *Aust N Z J Public Health* 2011; **35**: 117–21.
16. New South Wales Auditor-General's Report Performance Audit. *Physical Activity in Government Primary Schools Department of Education and Communities*. Audit Office of NSW, 2012.
17. World Health Organisation. *Population-Based Approaches to Childhood Obesity Prevention*. Geneva: World Health Organisation, 2012.
18. Brener ND, Everett-Jones S, Kann L *et al*. Methods: school health policies and practices study 2012. In: *Results from the School Health Policies and Practices Study 2012*. Atlanta: U.S. Department of Health and Human Services Centers for Disease Control and Prevention, 2013, 13–9.
19. Lee SM, Burgeson CR, Fulton JE *et al*. Physical education and physical activity: results from the school health policies and practices study 2012. In: *Results from the School Health Policies and Practices Study 2012*. Atlanta: U.S. Department of Health and Human Services Centers for Disease Control and Prevention, 2013, 33–48.
20. Centers for Disease Control and Prevention. *Competitive Foods in Schools*, 2013. Available at: <http://www.cdc.gov/healthyyouth/nutrition/standards.htm>. Accessed: 20 September 2014.
21. Hardy LL, King L, Espinel P *et al*. *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report*. Sydney: NSW Ministry of Health, 2010.
22. World Health Organisation. *Global Strategy on Diet, Physical Activity and Health*, 2004. Available at: <http://www.who.int/dietphysicalactivity/goals/en/index.html>. Accessed: 8 December 2013.
23. NSW Health. *NSW Child Obesity Summit Action Plan and Summit Response*, 2003. Available at: http://www0.health.nsw.gov.au/publichealth/healthpromotion/obesity/adult_gap.asp. Accessed: 8 December 2013.
24. NSW Department of Health. *NSW Government Plan for Preventing Overweight and Obesity in Children, Young*

- People & Their Families 2009-2011*. North Sydney: NSW Department of Health, 2009.
25. O'Dea JA. Whole-school and health promoting school approaches to obesity prevention government policy directions in Australia between 2000 and 2010. In: O'Dea JA, Eriksen MP (eds). *Childhood Obesity Prevention—International Research, Controversies and Interventions*. Oxford: Oxford University Press, 2010, 278–300.
26. NSW Department of Education and Training. *Policy Standards for Curriculum Planning and Programming, Assessing and Reporting to Parents K–12*. vol. 8. Sydney: NSW Department of Education and Training, 2006.
27. NSW Department of Health and NSW Department of Education and Training. *Fresh Tastes @ School NSW Healthy Canteen Strategy Canteen Menu Planning Guide*. Sydney: NSW Department of Health, 2006.
28. Healthy Kids Association. *Crunch&Sip*, 2007. Available at: <http://healthy-kids.com.au/teachers/crunch-sip/>. Accessed: 20 September 2014.
29. NSW Government. *Live Life Well @ School*, 2013. Available at: <http://www.healthykids.nsw.gov.au/campaigns-programs/live-life-well-at-school.aspx>. Accessed: 8th December 2013.
30. Centre for Health Advancement. *Implementation Plan for the Healthy Children Initiative*, 2010. Available at: http://www.federalfinancialrelations.gov.au/content/npa/health_preventive/healthy_children/NSW_IP_2013.pdf. Accessed: 20 September 2014.
31. NSW Department of Education and Training. *NSW School Locator*. Available at: <http://www.schools.nsw.edu.au/schoolfind/locator/>. Accessed: 18 September 2008.
32. Catholic Education Commission. *NSW Catholic Schools Directory*. Available at: <http://www.stage.cecnsw.catholic.edu.au>. Accessed: 18 September 2008.
33. Private Schools Directory. *Private Schools Directory NSW*. Available at: <http://www.privateschoolsdirectory.com.au/search.php>. Accessed: 18 September 2008.
34. Nathan N, Wolfenden L, Morgan PJ *et al.* Validity of a self-report survey tool measuring the nutrition and physical activity environment of primary schools. *Int J Behav Nutr Phys Act* 2013; **10**: 75.
35. Australian Bureau of Statistics (ABS). *Technical Paper: Census of Population and Housing: Socio-Economic Indexes for Australia (SEIFA)*. Cat. no 2039.0.55.001. Canberra: Commonwealth of Australia, 2001.
36. Australian Bureau of Statistics (ABS). *Statistical Geography Volume 1—Australian Standard Geographical Classification (ASGC)*. Cat. no 1216.0. Canberra: Commonwealth of Australia, 2006.
37. Nathan N, Wolfenden L, Bell AC *et al.* Effectiveness of a multi-strategy intervention in increasing the implementation of vegetable and fruit breaks by Australian primary schools: a non-randomised controlled trial. *BMC Public Health* 2012; **12**: 651.
38. Australian Government. *Programs and Projects of the Go for 2&5 Campaign*, 2005. Available at: <http://www.gofor2and5.hstprdw01.perthix.net/article.aspx?c=2&a=134&n=1>. Accessed: 8 November 2010.
39. Morgan PJ, Hansen V. Classroom teachers' perceptions of the impact of barriers to teaching physical education on the quality of physical education programs. *Res Q Exerc Sport* 2008; **79**: 506–16.
40. Sherman CP, Tran C, Alves Y. Elementary school classroom teacher delivered physical education: costs, benefits and barriers. *Phys Educ* 2010; **67**: 2–17.
41. Barosso CS, McCullum-Gomez C, Hoelscher DM *et al.* Self-reported barriers to quality physical education by physical education specialists in Texas. *J Sch Health* 2005; **75**: 313–9.
42. McKenzie TL, Sallis JF, Rosengard P. Beyond the Stucco tower: design, development, and dissemination of the SPARK physical education programs. *Quest* 2009; **61**: 114–27.
43. Faucette N, Nugent P, Sallis J *et al.* "I'd rather chew on aluminium foil." Overcoming classroom teachers' resistance to teaching physical education. *J Teach Phys Educ* 2002; **21**: 287–308.
44. Dowda M, James F, Sallis JF *et al.* Evaluating the sustainability of SPARK physical education: a case study of translating research into practice. *Res Q Exerc Sport* 2005; **76**: 11–9.
45. Waters E, de Silva-Sanigorski A, Hall BJ *et al.* Interventions for preventing obesity in children (Review). *Cochrane Database Syst Rev* 2011; CD001871.