



Body mass Index of children and adolescent participants in a voucher program designed to incentivise participation in sport and physical activity: A cross-sectional study

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ABSTRACT

There has been limited population-level success in tackling overweight and obesity. The Active Kids program is a universal intervention that aims to increase participation in structured physical activity and sport among children and adolescents in New South Wales (NSW), Australia. This study examined the prevalence of overweight and obesity across subgroups and by social disadvantage in this large broadly representative sample. A cross-sectional study was conducted including all children ($n = 671,375$) who registered for an Active Kids Program voucher in 2018. The child's height and weight were obtained from an online registration form. Among children and adolescents who registered in the Active Kids Program, the prevalence of overweight and obesity was 17.2% and 7.6%, respectively. A large number of children and adolescents who lived in the most disadvantaged areas ($n = 99,583$; 14.8%) registered for the program. There was a clear socio-economic gradient for obesity prevalence across areas of increasing disadvantage, with children and adolescents living in the most disadvantaged area being 1.87 (95% CIs 1.82, 1.93) times more likely to be overweight or obese. The Active Kids program successfully reached a substantial proportion of children who are overweight and obese from socio-economically disadvantaged areas, providing financial support and opportunities for these children to participate in structured sport and physical activity. However, the program did not reach all children, and additional physical activity promotion strategies may be needed in a comprehensive approach. Nonetheless, these findings support government investment in reaching children who are overweight or obese with large-scale programs.

1. Introduction

Overweight and obesity in childhood and adolescence are associated with adverse health consequences throughout the life course (Reilly and Kelly, 2011). As body mass index (BMI) increases, so does the prevalence of comorbid conditions, including cardiovascular disease, type 2 diabetes, and some cancers (Guh et al., 2009). Whilst many of these conditions occur in adulthood, early incidence of obesity poses immediate physical, social and mental health concerns during adolescence (Vallgård, 2018). Further, children and adolescents who are obese are five times more likely to be obese in adulthood than those who were not obese, representing a lifelong personal burden and long-term societal impacts (Lobstein et al., 2004).

To address the personal, social and economic burden of overweight

and obesity, the World Health Organisation recommended that member states set targets to reduce obesity by 2025 (World Health Organization, 2013). Targets have been set in many countries including the United States (US Department of Health and Human Services, 2010), the United Kingdom (Abidin et al., 2014), Canada (Ontario Ministry of Health and Long-Term Care, 2012), New Zealand (Vandevijvere and Swinburn, 2014) and Australia (NSW Government, 2016). In New South Wales, Australia, the State Government set a target to reduce childhood overweight and obesity by 5% by 2025. A recent review of progress towards this target in NSW found that it is theoretically possible to meet the target by implementing a comprehensive combination of cross-sectoral policies and programmes (Roberts et al., 2019). Such policies and programmes could include improvements to the build environment infrastructure (e.g., improving neighbourhood walkability), increasing

Abbreviations: ARIA, Accessibility and Remoteness Index of Australia; BMI, Body mass index; HEAL, Healthy Eating Active Living; IOTF, International Obesity Task Force; NSW, New South Wales; SEIFA, Socio-Economic Index for Area; SPANS, School Physical Activity and Nutrition Survey; WHO, World Health Organisation.

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opportunities for sport and active recreation (e.g., voucher programs to reduce the associated costs), policies to reduce sugar sweetened beverages and increase healthy food intake (e.g., tax on sugar sweetened beverages) and advertising restrictions on unhealthy food and beverages to children. These policies and programmes need to be universal and have strong reach into children with higher prevalence of overweight and obesity, such as socio-economically disadvantaged groups (Bellew et al., 2019).

While there has been some success with small scale interventions that target overweight and obesity (Brown et al., 2019), population approaches have had limited success (Bleich et al., 2018). In NSW between 2013 and 18, the Go4Fun program was an important component of the NSW Government's response to the prevention and treatment of childhood obesity (Hardy et al., 2015). The program aimed at improving the health, fitness and self-esteem of overweight and obese children through a two-hour weekly session delivered over a ten-week period in parallel with the school term. The 3,844 children who completed the program had an average weight reduction of 400 g and 0.6 BMI units, demonstrating some success in childhood obesity reduction. Overall, the program reached a total of 6,288 overweight or obese children, which is approximately 2% of eligible overweight and obese children in NSW.

Worldwide (Molema et al., 2016), and particularly in Australia, voucher programs have become increasingly popular, with five states or territories implementing schemes between 2011 and 2018 (Reece et al., 2020b). However, none of these voucher programs have assessed the reach of the program into children who are overweight or obese. As children who are overweight or obese need the program the most, especially those living in low socioeconomic areas due to the disparity in overweight and obesity across socioeconomic areas (Hardy et al., 2017), it is crucial to understand whether programs have reach into these children. The Active Kids program, led by the NSW State Government's Office of Sport, is a policy initiative to increase participation in structured physical activity and sport among children in NSW (Office of Sport, 2018; Reece et al., 2020a). In the 2018 calendar year, all school-enrolled children in NSW were eligible to register for one \$100 voucher that could be used towards the cost of an ≥ 8 -week membership or registration fee, with approved activity providers. Structured physical activities must involve moderate or vigorous levels of physical activity and can be undertaken through sport (e.g., basketball, soccer, tennis) or active recreation (e.g., dance, martial arts) organisations, outside of school hours. The Active Kids program achieved awareness across NSW through organic promotion. Families may have heard about the program through the media discourse and word of mouth. The Office of Sport also developed marketing collateral for approved Providers to promote their involvement in the program and encourage families to participate.

The Active Kids Program has been implemented state-wide for one calendar year. The reach of the program has been previously reported however data was not available to understand the reach of the Active Kids program to children who are overweight or obese (Foley et al., 2020). This information will inform policy makers and program deliverers and assist in improving this and future policy interventions on a national and international level aiming to address childhood overweight and obesity. The aim of this study was to examine the reach of the Active Kids program into children with overweight and obesity and examine socio-demographic subgroups of children with overweight and obesity.

2. Materials and methods

2.1. Study population

All primary and secondary school-enrolled children and adolescents, residing in NSW with a valid Australian Medicare card were eligible for an Active Kids voucher. To register children in the program, the parent, carer or guardian (adult) was required to complete an online registration form. All children who were registered for the program in 2018 were included in this cross-sectional study.

The Active Kids program registration form was designed by a multi-sector steering group to ensure the information collected included all relevant socio-demographic information. The registration form data obtained for this study includes the child's date of birth (validated by Medicare), sex, primary language spoken at home, Aboriginal identity, disability status, postcode, adult reported height and weight of the child and 7 day recall of physical activity participation (Prochaska et al., 2001). Once registration data was submitted, the Active Kids voucher, valued up to AUD \$100, was emailed to the adult. The Human Research Ethics Committee at University of Sydney granted approval for the evaluation of Active Kids (Project number: 2017/946).

3. Measures

Height and weight was reported by the parent or carer of each child and adolescent at the point of program registration. While parent-reported height and weight is subject to reporting bias (Weden et al., 2013; Wright et al., 2018), this data is widely used in population level surveillance systems (e.g., NSW Population Health Survey), and has been shown to provide relatively accurate overweight and obesity estimates (Skinner et al., 2018). BMI was calculated as weight divided by height squared (i.e., kg/m^2). Each child was categorised as thin, healthy weight, overweight or obese using the International Obesity Task Force (IOTF) definitions (Cole and Lobstein, 2012). The IOTF definitions provide age and sex specific BMI cut-offs for overweight and obesity based on representative data from six countries, and thus provide a standard international definition for childhood overweight and obesity.

Meeting physical activity guidelines was assessed using a single item reported by the parent or carer (Prochaska et al., 2001). The item asked, "In a typical week, how many days was the child physically active for at least 60 min?" There is evidence that this is a valid and reliable measure of physical activity in adolescents (Prochaska et al., 2001). In line with physical activity guidelines (Australian Government Department of Health and Ageing, 2019), children who reported being active on 7 days were categorised as meeting physical activity guidelines.

Sport participation was determined using a single item reported by the parent or carer. The item asked "Approximately, how many organised sessions of sport or physical activity has the child participated in, in total, outside of school hours, during the last 12 months?" Responses were categorised into at least four times a week, at least twice a week, at least once a week, at least once a month or none.

Demographic characteristics collected in the Active Kids registration form included age, sex, primary language spoken at home, Aboriginal and/or Torres Strait Islander status, disability status, SES, and remoteness. Disability status included physical, sensory, intellectual, psychiatric, or other health-related disabilities. Area level SES was determined using postcode of residence and categorised using the Socio-Economic Index for Area (SEIFA), specifically the Index of Relative Socio-Economic Disadvantage (Australian Bureau of Statistics, 2016), which ranks regions in Australia according to relative socioeconomic disadvantage. Postcode-based SEIFA percentiles were converted into quartiles, with the lowest 25% of postcodes classified as 1 (most disadvantaged area) and the top 25% of postcodes as 4 (least disadvantaged area). Location was assessed using postcode of residence and categorised using the Accessibility/Remoteness Index of Australia (ARIA+). ARIA+ groups areas on the basis of relative access to services into major city, inner regional, outer regional or remote (Australian Bureau of Statistics, 2018).

3.1. Statistical analysis

Descriptive statistics, including frequencies and proportions, were calculated for demographic characteristics across BMI categories for children and adolescents. Chi-squared tests were conducted to determine whether there were significant differences between those providing and not providing height and weight data. A multivariate

logistic regression model was conducted to determine which demographic characteristics were associated with an increased risk of overweight and obesity. We also used multivariate logistic regression models to test the interaction between SES and each demographic characteristic (i.e., age, sex, primary language spoken at home, Aboriginal and/or Torres Strait Islander status, disability status, and remoteness) to understand the reach of the program in the groups of children who are most at risk of overweight and obesity, such as Aboriginal and Torres Strait Islander children living in the most disadvantaged areas. These models adjusted for all demographic characteristics. We did a sensitivity analysis to address the high proportion of missing BMI data. We imputed missing BMI data using the multiple imputation by chained equations approach to create five datasets (Azur et al., 2011). We used linear regression and included all covariates in the imputation models. All analyses were performed in SAS Enterprise-Guide 9.4 (SAS Institute, Cary, NC, USA).

4. Results

Of the initial 671,375 parents who registered their children or adolescents for the Active Kids program in 2018, 306,450 (45.7%) provided height and weight data. Of these 1.1% were below or above the

International Obesity Taskforce cut points (Cole and Lobstein, 2012) and were excluded from the main analyses. Children who had valid height and weight data were significantly ($p < 0.001$) more likely to be older, boys, speak a language other than English at home, live in an area of higher SES, live in a major city, meet the physical activity guidelines, not identify as Aboriginal or Torres Strait Islander and not have a disability (Table 1). The overall sample prevalence of overweight and obesity was 17.2% and 7.6%, respectively (Table 2). Sensitivity analysis using multiple imputation found the overall sample prevalence of overweight and obesity was 21.4% and 8.8%, respectively.

The Active Kids program participants were on average 10.3 (SD = 3.4) years old and 56.4% were boys (Table 2). The majority spoke English at home (92%), were non-Indigenous (95%) and did not have a disability (97%). One in five participants met physical activity guidelines and less than half of the participants (43%) played sport at least twice a week.

The odds of overweight and obesity for children and adolescents registered in the Active Kids program are displayed in Table 3. There was an inverse relationship between SES and overweight or obesity, with Active Kids participants living in the most disadvantaged area being 1.91 (95% CIs 1.88, 1.95) times more likely to be overweight or obese compared with children and adolescents living in the least

Table 1
Descriptive statistics of children and adolescents in the Active Kids Program with and without body mass index data.

	Missing body mass index data		body mass index data		All		χ^2	p-value
	N	%	N	%	N	%		
All persons	364,925	54.4	306,450	45.7	671,375	100.0		
Age category							4308.2	<0.001
4–8	156,676	58.2	112,781	41.9	269,457	40.1		
9–11	102,498	55.1	83,433	44.9	185,931	27.7		
12–14	69,053	50.0	69,010	50.0	138,063	20.6		
15–18	36,698	47.1	41,226	52.9	77,924	11.6		
Sex							2173.1	<0.001
Boys	188,977	52.2	172,875	47.8	361,852	53.9		
Girls	174,968	56.7	133,575	43.3	308,543	46.0		
Primary language spoken at home							201.7	<0.001
English	339,195	54.6	282,040	45.4	621,235	92.5		
Other	25,730	51.3	24,410	48.7	50,140	7.5		
Aboriginal and/or Torres Strait Islander status							3128.0	<0.001
Yes	23,839	66.0	12,290	34.0	36,129	5.4		
No	335,010	53.5	291,678	46.5	626,688	93.3		
Prefer not to say	6076	71.0	2482	29.0	8558	1.3		
Disability							1241.3	<0.001
Yes	10,004	56.5	7711	43.5	17,715	2.6		
No	348,864	54.1	295,794	45.9	644,658	96.0		
Prefer not to say	5881	71.1	2396	29.0	8277	1.2		
Missing	176	24.3	549	75.7	725	0.1		
Socio-economic status quartile							6882.7	<0.001
1st (most disadvantaged)	63,089	63.4	36,494	36.7	99,583	14.8		
2nd	80,927	57.7	59,375	42.3	140,302	20.9		
3rd	86,780	54.7	72,003	45.4	158,783	23.7		
4th (least disadvantaged)	99,558	49.6	101,008	50.4	200,566	29.9		
Missing	34,571	47.9	37,570	52.1	72,141	10.8		
Location							4004.6	<0.001
Major Cities	234,979	53.3	205,797	46.7	440,776	65.7		
Inner Regional	74,510	58.9	52,084	41.1	126,594	18.9		
Outer Regional and remote	21,260	65.3	11,323	34.8	32,583	4.9		
Missing	34,176	47.9	37,246	52.2	71,422	10.6		
Met physical activity guidelines (7 days)							456.2	<0.001
No	298,120	55.0	244,027	45.0	542,147	80.8		
Yes	66,805	51.7	62,423	48.3	129,228	19.3		
Sport participation							14659.9	<0.001
None	8377	68.5	3861	31.6	12,238	1.8		
At least once a month	93,319	61.5	58,356	38.5	151,675	22.6		
At least once a week	116,280	53.4	101,598	46.6	217,878	32.5		
At least twice a week	72,414	49.1	75,202	50.9	147,616	22.0		
At least four times a week	45,317	44.7	55,973	55.3	101,290	15.1		
Not sure	29,061	71.8	11,406	28.2	40,467	6.0		
Missing	157	74.4	54	25.6	211	0.0		

Note. Chi-square and p-value tests the difference in proportion of children providing valid body mass data vs. not providing valid body mass data across demographic characteristic subgroups.

Table 2
Descriptive statistics of children and adolescents in the Active Kids Program by Body Mass Index categories.

	Thin		Healthy weight		Overweight		Obesity		All	
	N	%	N	%	N	%	N	%	N	%
All persons	35,357	11.5	195,166	63.7	52,675	17.2	23,252	7.6	306,450	100.0
Age category										
4–8	16,937	15.0	66,426	58.9	17,799	15.8	11,619	10.3	112,781	36.8
9–11	9106	10.9	51,717	62.0	16,049	19.2	6561	7.9	83,433	27.2
12–14	6317	9.2	47,395	68.7	12,000	17.4	3298	4.8	69,010	22.5
15–18	2997	7.3	29,628	71.9	6827	16.6	1774	4.3	41,226	13.5
Sex										
Boys	18,782	10.9	109,315	63.2	30,820	17.8	13,958	8.1	172,875	56.4
Girls	16,575	12.4	85,851	64.3	21,855	16.4	9294	7.0	133,575	43.6
Primary language spoken at home										
English	31,984	11.3	179,791	63.8	48,731	17.3	21,534	7.6	282,040	92.0
Other	3373	13.8	15,375	63.0	3944	16.2	1718	7.0	24,410	8.0
Aboriginal and/or Torres Strait Islander status										
Yes	1123	9.1	6771	55.1	2692	21.9	1704	13.9	12,290	4.0
No	33,944	11.6	186,848	64.1	49,565	17.0	21,321	7.3	291,678	95.2
Prefer not to say	290	11.7	1547	62.3	418	16.8	227	9.2	2482	0.8
Disability										
Yes	942	12.2	4379	56.8	1513	19.6	877	11.4	7711	2.5
No	34,048	11.5	189,088	63.9	50,570	17.1	22,088	7.5	295,794	96.5
Prefer not to say	298	12.4	1388	57.9	476	19.9	234	9.8	2396	0.8
Missing	69	12.6	311	56.7	116	21.1	53	9.7	549	0.2
Socio-economic status quartile										
1st (most disadvantaged)	3661	10.0	21,015	57.6	7472	20.5	4346	11.9	36,494	11.9
2nd	6334	10.7	37,065	62.4	10,863	18.3	5113	8.6	59,375	19.4
3rd	8259	11.5	45,219	62.8	12,829	17.8	5696	7.9	72,003	23.5
4th (least disadvantaged)	12,831	12.7	68,366	67.7	14,755	14.6	5056	5.0	101,008	33.0
Missing	4272	11.4	23,501	62.6	6756	18.0	3041	8.1	37,570	12.3
Location										
Major Cities	24,316	11.8	131,832	64.1	34,614	16.8	15,035	7.3	205,797	67.2
Inner Regional	5714	11.0	33,052	63.5	9176	17.6	4142	8.0	52,084	17.0
Outer Regional and remote	1097	9.7	6992	61.8	2183	19.3	1051	9.3	11,323	3.7
Missing	4230	11.4	23,290	62.5	6702	18.0	3024	8.1	37,246	12.2
Met physical activity guidelines (7 days)										
No	27,247	11.2	153,681	63.0	43,527	17.8	19,572	8.0	244,027	79.6
Yes	8110	13.0	41,485	66.5	9148	14.7	3680	5.9	62,423	20.4
Sport participation										
None	556	14.4	2081	53.9	692	17.9	532	13.8	3861	1.3
At least once a month	7430	12.7	33,360	57.2	10,976	18.8	6590	11.3	58,356	19.0
At least once a week	11,975	11.8	63,881	62.9	17,827	17.6	7915	7.8	101,598	33.2
At least twice a week	8339	11.1	49,853	66.3	12,503	16.6	4507	6.0	75,202	24.5
At least four times a week	5807	10.4	38,951	69.6	8593	15.4	2622	4.7	55,973	18.3
Not sure	1242	10.9	7007	61.4	2077	18.2	1080	9.5	11,406	3.7
Missing	8	14.8	33	61.1	7	13.0	6	11.1	54	0.0

disadvantaged area.

Interactions were tested between SES and all demographic characteristics (i.e., age, sex, primary language spoken at home, Aboriginal identity, disability status, and location). Significant interactions were found between SES and age, Aboriginal identity and location and are described in the following paragraphs (Table 4).

Within each age group, the predicted probability of overweight or obesity decreased as socioeconomic disadvantage increased. For example, the predicted probability of overweight or obesity for 9–11 year olds living in the most disadvantaged area was 39.4% compared with 23.6% living in the least disadvantaged area. Across all socioeconomic areas, children (4–11 year olds) had a significantly higher predicted probability of overweight or obesity compared with adolescents (12–18 year olds).

Within each level of socioeconomic status (SEIFA quartile), the predicted probability of overweight or obesity was significantly higher for Aboriginal and Torres Strait Islander children and adolescents compared with Non-Aboriginal and Torres Strait Islander children and adolescents. For Non-Aboriginal and Torres Strait Islander children and adolescents, the probability of overweight or obesity decreased as the SEIFA quartile increased. However, for Aboriginal and Torres Strait Islander children and adolescents, the probability of overweight or obesity remained consistently high across the 1st, 2nd and 3rd SEIFA quartiles and decreased in the 4th SEIFA quartile.

Within location categories, the probability of overweight or obesity increased as socioeconomic disadvantage increased. In the most disadvantaged area, children and adolescents living in major cities had a significantly higher probability of overweight or obesity (38.6% in major cities, compared with 31.3% in inner regional and 32.9% in outer regional and remote).

5. Discussion

In 2018, the Active Kids program successfully reached 75,927 children who were overweight or obese, which is approximately 25% of all eligible children who were overweight and obese (NSW PHS 2017–18). This could be closer to 30% of all eligible children based on the results of our sensitivity analysis that imputed BMI data for those who did not report it. The prevalence of overweight or obesity in children and adolescents aged 4–18 years was 23.9%. Two NSW population surveys have reported a similar obesity prevalence. The 2015 NSW School Physical Activity and Nutrition Survey (SPANS) reported that 24.5% of school-aged children and adolescents were overweight or obese using objectively measured height and weight. The 2017 NSW Population Health Survey found that 21.4% of children aged 5–16 years were overweight or obese using a similar measure of parent-reported height and weight. The Active Kids program aims to reduce overweight and obesity, and to do this it needs to reach children who are overweight or obese. These

Table 3
Odds of overweight and obesity for children and adolescents in the Active Kids program.

	Prevalence N (%)	Overweight and obesity OR (95% CIs)
All persons	75,927 (24.8)	
Age category		
4–8	29,418 (26.1)	1.60 (1.57, 1.63)
9–11	22,610 (27.1)	1.61 (1.58, 1.64)
12–14	15,298 (22.2)	1.13 (1.11, 1.16)
15–18	8,601 (20.9)	Ref
Sex		
Boys	44,778 (25.9)	1.13 (1.11, 1.14)
Girls	31,149 (23.4)	Ref
Primary language spoken at home		
English	70,265 (24.9)	1.23 (1.21, 1.26)
Other	5,662 (23.2)	Ref
Aboriginal and/or Torres Strait Islander status		
Yes	4,396 (35.8)	1.59 (1.55, 1.63)
No	70,886 (24.3)	Ref
Disability		
Yes	2,390 (31.0)	1.19 (1.15, 1.23)
No	72,658 (24.6)	Ref
Socio-economic status quartile		
1st (most disadvantaged)	11,818 (32.4)	1.91 (1.88, 1.95)
2nd	15,976 (26.9)	1.52 (1.49, 1.54)
3rd	18,525 (25.7)	1.39 (1.37, 1.41)
4th (least disadvantaged)	19,811 (19.6)	Ref
Location		
Major Cities	49,649 (24.1)	1.02 (0.99, 1.05)
Inner Regional	13,318 (25.6)	0.94 (0.91, 0.96)
Outer Regional and remote	3,234 (28.6)	Ref
Met physical activity guidelines (7 days)		
No	63,099 (25.8)	Ref
Yes	12,828 (20.6)	0.73 (0.72, 0.74)
Sport participation		
None	1,224 (31.7)	Ref
At least once a month	17,566 (30.1)	0.84 (0.82, 0.87)
At least once a week	25,742 (25.4)	0.70 (0.68, 0.73)
At least twice a week	17,010 (22.6)	0.67 (0.65, 0.69)
At least four times a week	11,215 (20.1)	0.54 (0.52, 0.56)

Table 4
Predicted probabilities of overweight and obesity for children and adolescents by socioeconomic status in the Active Kids Program.

	Socioeconomic status quartile			
	1st (most disadvantaged)	2nd	3rd	4th (least disadvantaged)
Age category				
4–8	37.7	32.1	31.5	26.2
9–11	39.4	33.4	31.8	23.6
12–14	32.8	26.4	25.3	18.7
15–18	29.9	25.4	23.2	16.6
Aboriginal and/or Torres Strait Islander status				
Yes	40.9	39.3	39.4	30.3
No	35.6	29.4	28.7	22.4
Location				
Major Cities	38.6	30.6	29.4	22.4
Inner Regional	31.3	29.2	27.5	24.2
Outer Regional and remote	32.9	31.4	27.5	20.1

Note. Interactions between socio-economic status and sex, primary language spoken at home, and disability status were not significant.

findings suggest that the program is reaching children who are overweight or obese.

In 2018, the Active Kids program reached 53% (N = 671,375) of the NSW population of school-enrolled children in 2018; however, the program only reached 38% of children living in the most disadvantaged

areas (Foley et al., 2020). Families living in the most disadvantaged areas are more likely to be unaware of the program (Owen et al., 2020). Among the children and adolescents who registered for the Active Kids Program, clear socio-economic gradients were noted for obesity prevalence across areas of increasing disadvantage. Within the lowest SES area, children and adolescents who were younger, Aboriginal and Torres Strait Islander, or lived in major cities had higher levels of overweight or obesity. These findings are consistent with recent population surveillance identifying disparities in childhood overweight and obesity between subgroups, especially children living in low SES areas, even though overall childhood overweight and obesity rates have stabilised in many countries including Australia (Hardy et al., 2017). This socio-economic disparity in overweight and obesity highlights the importance of ensuring large universal programs can reach the children and adolescents who are most at need. These universal programs should consider proportionately targeting children living in the most disadvantaged areas to prevent a widening of the socioeconomic gradient. For example, partnerships with community stakeholders for program promotion or marketing campaigns in these areas could increase awareness and uptake of the program in disadvantaged children.

Among children in the Active Kids program, prevalence of overweight and obesity was higher in Aboriginal and Torres Strait Islander children compared to non-Aboriginal and Torres Strait Islander children. This finding is consistent with previous reports (Australian Bureau of Statistics, 2014). These high levels of overweight and obesity among Aboriginal and Torres Strait Islander children are concerning as children who are overweight or obese are likely to remain overweight or obese into adulthood (Simmonds et al., 2016; Singh et al., 2008). Adult overweight and obesity is one of the contributing factors to the health and life expectancy disparities between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians (Vos et al., 2009). The Active Kids program reached 61% of all eligible Aboriginal and Torres Strait Islander children (Foley et al., 2020). This finding is promising as the Active Kids program was not specifically designed for Aboriginal and Torres Strait Islander children and shows that universal programs can reach Aboriginal and Torres Strait Islander children who are overweight or obese. Qualitative research should be conducted with Aboriginal and Torres Strait Islander children to explore why this program was successful in reaching them and leverage this program strength. Universal programs, such as the Active Kids program, alongside specific culturally appropriate programs developed in collaboration with the Aboriginal community will be imperative in reducing the inequalities in overweight and obesity in Aboriginal and Torres Strait Islander children.

While there was no difference in the prevalence of overweight and obesity between children living in different locations (i.e., major cities, regional and remote areas), the interaction between location and SES did show clear patterns. Within each SEIFA quartile, children living in major cities had higher levels of overweight or obesity. The greatest disparity for children living in major cities was seen in the most disadvantaged area, where the prevalence of overweight or obesity was 38%, compared with 30% for children living in inner regional areas, and 33% for children living in outer regional area. Children living in disadvantaged areas in major cities in NSW could face a number of unique barriers to living a healthy lifestyle. Some of these barriers include land use issues (e.g., high access to energy-dense, nutrient poor foods and lack of supermarkets that supply fresh healthy food), infrastructure and maintenance issues (e.g., lack of sidewalks and street lighting), and social environment issues (e.g., high crime rates and the fear of crime) (Giles-Corti et al., 2016; Kjellstrom et al., 2007).

Overall, the patterns of overweight and obesity across subgroups were as expected and consistent with previous research. However, one exception to this was age, 24-2 as obesity declined with age among Active Kids registrants. The prevalence of obesity in 15–18 year olds was half that observed among 4–8 year olds. This is initially counter-intuitive as other population studies show increases in obesity through

adolescence (Hardy et al., 2016). This is likely due to the differential self-selection effects in Active Kids sample. Young children are less selected, as all groups and all weight ranges participate in sport, especially swimming lessons. However, participation in physical activity and sport is known to decline with age (Eime et al., 2016), thus, our older adolescent sub-group is likely to be represented by those adolescents who maintain sport and physical activity, and show selection effects in fewer of them being overweight or obese. There is potential to increase the representativeness of the mid-older adolescents by more focused targeting of Active Kids to those aged 15 years and older, especially focusing on those who have dropped out of structured sport. Adolescence is the age where sport participation typically declines (Eime et al., 2015) and future research is needed to understand the reasons for this and the role a program like Active kids could play to prevent drop out.

The major strength of the Active Kids program and this study is the large sample of children and adolescents who participated in the program and provided height and weight data. This large sample ($n = 239,433$) allowed the examination of subgroup estimates of overweight and obesity with precision. There were also some limitations to this study which must be considered when interpreting the findings. First, as the Active Kids data was cross-sectional, no determination of causality between variables (e.g., physical activity) and overweight or obesity is implied. Second, this study could have underestimated the prevalence of overweight or obesity due to missing data, reporting bias by parents, social desirability bias and selection bias. Our sensitivity analysis with multiple imputation suggests that this study could have underestimated the prevalence by 5.4%. We recommend that height and weight should be compulsory fields to increase the data integrity and validity of overweight and obesity estimates. Also, parents may mis-specify weight in adolescents and children where the true BMI values are in the upper end of the BMI distribution (Weden et al., 2013; Wright et al., 2018). However, parent-reported height and weight data is widely used in surveillance systems, such as the NSW PHS and has been shown to provide relatively accurate overweight and obesity estimates (Skinner et al., 2018). Selection bias may have occurred differentially, as this sample consisted of children and adolescents who registered for an Active Kids voucher, and especially older overweight or obese adolescents are less likely to participate in sport less likely to register for the voucher (Steinacker, 2013). Third, the sport participation question has not been validated. However, this question has been used since 2016 in the annual representative national sport survey, AusPlay (Australian Sports Commission, 2020).

6. Conclusions

The Active Kids program successfully reached a substantial proportion of children who are overweight and obese across the NSW state population, including many living in low SES areas and/or identifying as Aboriginal and Torres Strait Islander. The program provided financial support and opportunities for these children to participate in structured physical activity and structured sport. As such, it contributes to the NSW Government priorities to reduce overweight and obesity rates in children (NSW Government, 2016). However, there is still potential to improve the reach of the program by further targeting socially disadvantaged groups, and adolescents. The clear socio-economic gradient for obesity prevalence was maintained across age and other sub-groups and warrants specific programmatic efforts. Continued evaluation of the Active Kids program provides policy-relevant information to guide future implementation of this program to increase physical activity and sport participation in children and adolescents on a large scale.

CRedit authorship contribution statement

Katherine B. Owen: Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Writing - original draft. **Bill Bellew:** Conceptualization, Writing - review & editing. **Bridget C.**

Foley: Conceptualization, Writing - review & editing. **Adrian Bauman:** Conceptualization, Methodology, Writing - review & editing, Supervision. **Lindsey J. Reece:** Conceptualization, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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