Trends in children's physical activity and weight status in high and low socio-economic status areas of Melbourne, Victoria, 1985-2001

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Abstract

Objective: To examine trends in active transport to and from school, in school sport and physical education (PE), and in weight status among children from high and low socio-economic status (SES) areas in Melbourne, Victoria, between 1985 and 2001.

Methods: Cross-sectional survey data and measured height and weight from 1985 (n=557) and 2001 (n=926) were compared for children aged between 9-13 years within high and low SES areas.

Results: From 1985 to 2001, the frequency of walking to or from school declined (4.38±4.3 vs. 3.61±3.8 trips/wk, $p<0.001$), cycling to or from school also declined (1.22±2.9 vs. 0.36±1.5 trips/wk, $p<0.001$), and the frequency of PE lessons declined (1.64±1.1 vs. 1.18±0.9 lessons/wk, $p<0.001$). However, the frequency of school sport increased (0.9±1.22 vs. 1.24±0.8 sessions/wk, $p<0.001$). In 1985, 11.7% of children were overweight or obese compared with 28.7% in 2001 ($p<0.001$). Apart from walking to school and school sport, there were greater relative declines in cycling to school and PE, and increases in overweight and obesity among children attending schools in low SES areas compared with those attending schools in high SES areas.

Conclusions: Declines in active school transport and PE have occurred at the same time as increases in overweight and obesity among Australian children.

Implications: Promoting active school transport and maintaining school sport and PE should be important public health priorities in Australia. Current inequities in school sport and PE and in prevalence of overweight and obesity by area-level SES also need to be addressed.

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Population increases in overweight and obesity among Australian children are well documented.[1,2] In 1997, approximately one in five children in New South Wales, Victoria and South Australia were overweight or obese, which was more than double the prevalence in 1985.[1] Of particular concern, there is evidence to suggest that weight status is not distributed equitably among children in the population, with significantly lower rates of body fatness among girls living in high socio-economic status (SES) areas compared with those in middle and low SES areas.[3] To date, SES differentials in trends in overweight and obesity have not been reported in Australia.

In general, the increasing prevalence of overweight and obesity has been largely attributed to poor dietary intake and inadequate physical activity. There is evidence that the energy density of children's diets has increased between 1983 and 1995.[4] There is some evidence of declines in fitness among children;[5,6] however, recent population estimates of organised sport among 5-14 year-olds suggest that participation has remained stable over the short period between 2000 and 2003.[7] Children's physical activity can consist of organised sport, active play, school physical education (PE) and sport, and active transport. There is very little published trend data available in Australia on children's active play, participation in school PE and sport, or active school transport (walking or cycling to or from school), and little data on SES differentials in these behaviours. Using cross-sectional survey data collected in 1985 and 2001, this report examines trends in active transport to and from school, in school sport and PE, and in weight status among children from high and low SES areas in Melbourne, Australia.

Method

Participants and procedures

In 1985, the Australian Council for Health, Physical Education and Recreation's (ACHPER) Australian Schools Health and Fitness Survey (ASHFS) collected extensive data on the health and fitness of a nationally representative sample of 8,484 children aged 7-15 years.[8] Schools were selected with a probability proportional to size in the first stage, and simple random sampling was used within each age and sex category to select children from within those schools in the second stage of sampling. Most invited schools (90%) agreed to participate, and informed consent was obtained from 77.5% of parents whose children were approached. Participants aged 9-15 years (n=6,659) were surveyed about their school-related physical activity behaviours under guided supervision by trained data collectors. For matching

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purposes between the two surveys, only data from children aged 9-13 years who attended metropolitan government schools in Melbourne, Victoria, are reported here (n=557). These data were collected between July-September 1985.

In 2001, children aged 9-13 years in the Children's Leisure Activities Study Survey (CLASS)[9] were recruited from fifth and sixth grade from 19 government primary schools in high (n=10) and low (n=9) socio-economic areas of Melbourne, Australia.[10] Schools with enrolments of greater than 200 children were selected using stratified random sampling proportionate to school size, and schools that declined to participate (five schools) were replaced with the next school on the randomly generated list (80% response rate). Recruitment continued until minimum sample sizes were achieved. Informed consent was obtained from 926 children in grades 5 and 6 and their parents (44% response rate). Between July-December 2001, data were collected alternately from children attending schools in high and low SES areas. Children completed questionnaires in the classroom under guided supervision by trained data collectors.

Socio-economic status

Socio-economic status (SES) of the schools was quantified based on the Australian Bureau of Statistics Socio-economic Index of Relative Disadvantage for areas (SEIFA).[10,11] SEIFA is a summary index designed to measure different aspects of SES by geographical area, based on questions asked in the Australian population Census (1986 Census for the ASHFS data and 1996 Census for the CLASS data). Its methodology has essentially remained the same since the SEIFA was first produced in 1990 based on the 1986 Census.[12] This index incorporates attributes such as income, educational attainment, unemployment, and jobs in relatively unskilled occupations. Schools in the 1985 and 2001 surveys were categorised as 'high' SES if they were located in a Statistical Local Area with a SEIFA score above the national median (>1,000) and 'low' SES if they were located in an area below the national SEIFA median.

Measures

Survey questionnaire

In 1985, children were asked how many times they had travelled to school by bicycle, travelled to school by walking, participated in PE, and participated in school sport (children were asked to list up to two school sports) in the last week. PE is defined as the process through which sport, outdoor education, dance, gymnastics, aquatics and games are used by physical educators to teach students motor skills and fitness skills as well as assisting with the school's responsibility to develop personal and social skills in students, whereas school sport is defined as "physical activity that, for the purposes of discovering the limits of one's capabilities, or for fun, amusement and diversion, involves competition against oneself or another, or a confrontation with natural elements".[13] Children were also asked to report their mother's and father's country of birth and the usual language spoken at home.

In 2001, children completed the CLASS questionnaire about their usual frequency of walking and cycling to and from school and participation in school sport and physical education classes during the week ("Which of the following physical activities do you usually do during a typical week?" "How many times Monday-Friday?"). These self-report measures have been shown to have acceptable reliability.[14] Parents completed a questionnaire providing demographic information about the mother's and father's country of birth and the usual language spoken at home.

In addition to examining the trends in frequency of walking and cycling to or from school and frequency of school sport and PE as continuous data for both surveys, responses to the walking frequency questions were collapsed into three categories: 'never', '1-5 times/wk', '6-10 times/wk'. As few children in the 2001 sample cycled to or from school, responses to the cycling frequency questions were collapsed into just two categories: 'never', '1-10 times/wk'. Responses to the school sport and PE frequency questions were collapsed into three categories: 'never', 'once/wk', '≥2 times/wk'.

Height and weight

In both 1985 and 2001, weight (kg) was measured using calibrated digital scales and height (cm) was measured using a portable stadiometer. Children removed shoes and socks for all measures and were lightly clothed. Children's body mass index (BMI=kg/m^2) was calculated using internationally accepted age- and sex-specific cut-points to define overweight and obesity.[15]

Statistical analyses

Analyses were performed using SPSS-PC version 11.5. Descriptive statistics were employed to characterise and compare the two samples. Independent *t*-tests were used to examine

Table 1: Demographic characteristics of 9-13 year-old children in the ASHFS 1985 and the CLASS 2001, Melbourne.

		ASHFS 1985	CLASS 2001	*p*-value
	(n)	(557)	(926)	
Sex (% boys)		49.2	46.0	0.238
	(n)	(550)	(907)	
Age (M years, SD)		11.4 (1.4)	11.5 (0.6)	0.234
	(n)	(556)	(882)	
Height (M centimetres, SD)		145.1 (10.3)	148.7 (7.7)	<0.001
	(n)	(557)	(882)	
Weight (M kg, SD)		39.2 (9.5)	44.0 (10.9)	<0.001
	(n)	(556)	(926)	
Mother born in Australia (%)		68.0	55.8	<0.001
	(n)	(557)	(926)	
Father born in Australia (%)		57.8	55.6	0.215
	(n)	(544)	(913)	
English spoken at home (%)		86.0	93.2	<0.001
	(n)	(548)	(926)	
Schools from high SES areas (%)		78.5	62.4	<0.001

differences in the frequency of children's walking and cycling to school, and the frequency of children's participation in school sport and PE between 1985 and 2001. Differences by area-level SES within survey years and also stratified by area-level SES were examined. The percentage distribution and confidence intervals were presented for the categorical data. Significance levels were set at $p<0.01$. Because of the possibility of the 1985 survey being underpowered to detect differences in physical activity and weight status by SES, ordinal regression analyses were performed and, provided the proportional odds assumption was not violated, the combined relative risk (95% CI) was then calculated.

Results

Demographic characteristics of the 1985 and 2001 samples are presented in Table 1. There were no differences in the proportions of boys and girls in the 1985 and 2001 samples and no differences in age. However, there were significant differences in height and weight between the samples. Although a higher percentage of mothers in the 1985 sample were born in Australia, a higher proportion of families in the 2001 sample spoke English at home. There were significantly greater proportions of children attending schools in high SES areas in the 1985 sample compared with the 2001 sample.

Differences in physical activity and weight status by SES areas within survey year

Table 2 shows that within the 1985 sample, there was a significant difference in children's walking to school between the two SES areas (p=0.007). Children in high SES areas were 1.7 times more likely to walk to school (95% CI 1.2-2.5) compared with children in low SES areas. There were no other significant differences by SES in 1985. In 2001, children attending schools in low SES areas walked to and from school more frequently than children attending schools in high SES areas ($p<0.01$). Conversely, independent t-tests showed that children attending schools in low SES areas participated in fewer sessions per week of school PE ($p<0.001$) and school sport ($p<0.001$) compared with children attending schools in high SES areas. In addition, nominal regression revealed that children from high SES areas were 2.8 times more likely to engage in school sport (95% CI 2.1-3.9) compared with those in low SES areas ($p<0.001$). Children in high SES areas were 3.2 times more likely to participate in two or more sessions (than never) of PE per week (95% CI 2.6-4.0, $p<0.001$).

There were also significantly more children from schools in low SES compared with high SES areas who were classified as overweight or obese ($p<0.001$) in the 2001 sample. Nominal

Table 2: Trends in walking or cycling to or from school, participation in school physical education (PE), school sport and weight status[a] overall and by SES[b] areas in ASHFS 1985 and CLASS 2001, Melbourne.

			Low SES		High SES	
	ASHFS 1985	CLASS 2001	ASHFS 1985	CLASS 2001	ASHFS 1985	CLASS 2001
Frequency of walking (n)	(548)	(913)	(118)	(344)	(430)	(569)
Mean times/wk (SD)	4.38 (4.3)	3.61 (3.8)[c]	3.62 (4.3)	4.05 (4.2)	4.61 (4.2)	3.34 (3.5)[c]
Never % (95% CI)	40.4 (36-44)	38.3 (34-42)	50.8 (42-60)	38.4 (32-44)	37.0 (33-41)	38.3 (34-42)
1-5 times/wk % (95% CI)	22.4 (18-26)	35.9 (32-40)	20.3 (13-27)	29.7 (26-34)	23.5 (20-27)	39.7 (36-44)
6-10 times/wk % (95% CI)	37.2 (33-41)	25.7 (24-28)	28.8 (18-37)	32.0 (36-43)	39.5 (36-43)	22.0 (18-26)
Frequency of cycling (n)	(548)	(913)	(118)	(344)	(430)	(569)
Mean times/wk (SD)	1.22 (2.9)	0.36 (1.5)[c]	1.76 (3.5)	0.25 (1.3)[c]	1.1 (2.6)	0.42 (1.6)[c]
Never % (95% CI)	80.4 (76-84)	91.7 (90-94)	76.3 (68-84)	94.5 (92-96)	81.6 (78-85)	90.0 (88-92)
1-10 times/wk % (95% CI)	19.6 (16-23)	8.3 (6-10)	23.7 (16-31)	5.5 (3-7)	18.4 (14-22)	10.0 (8-12)
Frequency of PE (n)	(548)	(905)	(118)	(343)	(430)	(562)
Mean times/wk (SD)	1.64 (1.1)	1.18 (0.9)[c]	1.75 (1.4)	0.97 (0.9)[c]	1.62 (1.0)	1.31 (1.1)[c]
Never % (95% CI)	13.6 (12-16)	17.0 (15-19)	18.6 (11-27)	18.1 (14-22)	12.3 (8-16)	16.4 (12-20)
Once/wk % (95% CI)	34.6 (31-38)	60.8 (57-65)	31.4 (23-39)	73.8 (70-78)	34.9 (31-39)	52.8 (49-57)
≥2 times/wk % (95% CI)	51.7 (48-56)	22.2 (20-24)	50.0 (40-60)	8.2 (6-10)	52.8 (49-57)	30.8 (27-35)
Frequency of school sport (n)	(548)	(914)	(118)	(347)	(430)	(567)
Mean times/wk (SD)	0.9 (1.2)	1.24 (0.8)[c]	0.81 (1.3)	1.0 (0.7)	0.90 (1.2)	1.35 (0.9)[c]
Never % (95% CI)	48.5 (44-52)	8.5 (6-10)	57.6 (49-67)	12.4 (8-16)	45.6 (42-49)	6.2 (4-8)
Once/wk % (95% CI)	31.4 (27-35)	70.7 (68-74)	26.3 (18-34)	77.5 (73-81)	33.3 (29-37)	66.5 (72-70)
≥2 times/wk % (95% CI)	21.0 (17-25)	20.8 (19-23)	16.1 (10-22)	10.1 (6-14)	21.2 (17-25)	27.3 (23-31)
Weight status (n)	(549)	(862)	(115)	(312)	(425)	(550)
Under/acceptable weight % (95% CI)	88.3 (86-90)	71.3 (68-74)	87.8 (82-94)	64.1 (58-70)	88.2 (85-91)	75.3 (71-79)
Overweight % (95% CI)	10.6 (9-13)	21.6 (20-24)	12.2 (6-18)	26.0 (22-30)	10.4 (8-12)	19.1 (15-23)
Obese % (95% CI)	1.1 (0.2-2)	7.1 (5-9)	0	9.9 (6-14)	1.4 (0.4-2)	5.5 (3-7)

Notes:

(a) Cut-off points for BMI in childhood based on international data linked to the widely accepted adult cut-off points for overweight (BMI 25.0-29.9 kg/m^2) and obesity (≥30.0 kg/m2).[15]

(b) SES – based on Socioeconomic Index for Areas in 1986[11] and 1996.[10]

(c) p<0.001 based on independent t-tests between survey years, overall and stratified by SES.

regression confirmed a significant difference between children in the two SES areas by weight status (p=0.001), with children from high SES areas 1.7 times more likely to be under/acceptable weight (95% CI 1.3-2.4) compared with children from low SES areas.

Trends in children's active transport

Table 2 shows that children walked to and from school less frequently in 2001 compared with 1985. This trend varied by SES, with approximately a 50% decline in walking 6-10 times/wk among children attending schools in high SES areas; however, for those attending schools in low SES areas the confidence intervals were overlapping in the comparison between survey years. There was approximately an 80% decline in the proportion of children cycling to school at least once per week from 1985 to 2001, with a greater decline in cycling to school among children attending schools in low SES areas (77% decline) compared with children in high SES areas (just under 50% decline).

Trends in children's PE and school sport

There were significant declines in the frequency of school sport sessions per week between 1985 and 2001, with the proportion of children engaged in one PE session per week increasing over this 16-year period, but the proportion of children participating in two or more PE sessions per week decreasing (see Table 2). Declines in the latter were much greater among children attending schools in low SES areas (84% decline) compared with those in high SES areas (42% decline). There were significant increases in the mean frequency of school sport between 1985 and 2001. However, this increase was not reflected among children attending schools in low SES areas. Furthermore, there was a 37% decrease in the proportion of children from schools in low SES areas attending ≥2 school sport sessions per week, compared with a 22% increase among children from schools in high SES areas.

Trends in weight status

Table 2 shows that in 1985, 11.7% of children were overweight or obese compared with 28.8% in 2001. Between 1985 and 2001, there were slightly higher increases in overweight and obesity prevalence among children attending schools in low SES areas (60% increase) compared with children attending schools in high SES areas (52% increase).

Discussion

This study suggests that between 1985 and 2001, among children aged 9-13 years attending government primary schools in Melbourne, there have been declines in the mean frequency of PE and walking and cycling to or from school, and increases in the frequency of school sport and the proportion of children classified as overweight or obese. Of particular concern, trends over this 16-year period appear stronger among children attending schools in low SES areas with significant declines in the frequency of walking to or from school, cycling to or from school, and school PE, no significant changes in school sport, and significant increases in overweight and obesity.

In 2001, children's reported active transport to and from school was consistent with findings from a recent study on children's active transport in South Australia.[16] In that study, 6% of children cycled and 26% walked to or from school on the previous day. In comparison, a survey of children's travel to school conducted in Melbourne in 1994 found that 3% cycled to and from school, 30% of children walked to school and 35% walked from school, on the day of the survey.[17] Variations in assessment (one study used a same-day recall by parents[17] and the other a previous-day recall reported by the child[16]) make it difficult to compare with the current study findings. A major strength of the current study was the similarity in the measures used in 1985 and 2001. Both surveys used child-report methods, and recall of frequency of walking and cycling to and from school and participation in PE and school sport was over a one-week period.

A further consistency between the data from 2001 reported in this study and the recent South Australian study[16] was the finding that children's frequency of walking to or from school varied by SES. In the South Australian study, out of 11 schools randomly selected from all primary schools listed in that State, eight primary schools from central, suburban, and outer areas participated. It was found that children living in the top SEIFA tertile (high SES) were almost 65% less likely to make active trips compared with those living in the lowest SEIFA tertile (low SES). In the current study, in contrast to the 1985 data, the mean frequency of walking to or from school in 2001 was higher among children from schools in low SES areas compared with those from schools in high SES areas. Furthermore, the decline in frequency of walking to school between 1985 and 2001 was greater among children in high SES areas compared with those in low SES areas. It may be that fewer families living in low SES areas have a car available to drive their child to or from school.[18] Or it may be that children attending schools in low SES areas are more likely to live within walking distance to school, whereas children attending schools in high SES areas may need to be driven as they live too far away to walk. In the 1990s, schools in Victoria changed their student enrolment policies from those living within the school zone to also recruiting children who live outside of the school zone. This may have resulted in schools in high SES areas attracting children from outside the district and therefore living too far to walk or cycle. Furthermore, parents of children who attend schools in high SES areas may have strong concerns about safety and the risks of active transport. More research on the distance that children live from school and the individual, social, and environmental influences on active transport is required.

Declines in the mean frequency of school PE from 1985 to 2001 appears to have been offset by increases in the frequency of school sport. This may be the result of the PE and sport requirement in schools in Victoria that was mandated in 1993.[19] The mandate states that children in school years 4-6 should receive three hours per week of timetabled PE and school sport, with at least 50% allocated to PE. Although only frequency and not

duration of PE sessions were available in this study, the finding that the frequency of PE sessions has significantly declined, particularly for children attending schools in low SES areas, and that children in those areas report significantly fewer school sport sessions per week, accentuates the need to monitor and maintain the mandate. Furthermore, even if duration data were available, this may not necessarily equate with 'active' involvement.[20]

The greater decline in the frequency of PE and non-significant increase in the frequency of school sport among children attending schools in low SES areas is of particular concern and may be due to poorer resourcing within low SES schools, a lack of specialist PE teachers, difficulties attracting teachers with sufficient skills to teach PE or school sport, a lack of commitment to school sport or PE, pressure from parents to focus more on the school's academic curriculum, or other potential priorities and challenges among schools in these areas. These data are consistent with studies of US adolescents that have found inverse relationships between school and neighbourhood-level SES and PE lessons and vigorous-intensity physical activity.[21,22] As for adults,[23] the relationship between SES and physical activity among children may vary depending on the SES indicator, and the contexts and domains of the activity.

Overall trends in overweight and obesity between 1985 and 2001 may be related to differences in physical activity between these time points. Declines in active transport to or from school and in PE sessions may have, in part, contributed to increases in the prevalence of childhood overweight and obesity. However, it is important to recognise that other factors may also have contributed to these trends, such as increases in energy intake[4] and the time that children spend in sedentary recreation, and participation in organised sport and other vigorous types of activities.[24] Conversely, the higher proportion of overweight or obese children in the 2001 sample could also be a reason for lower levels of activity among these children. Examination of the physical activity data according to weight status, however, revealed that trends in physical activity were consistent irrespective of weight status (data not shown). The Health of Young Victorians Survey (HOYVS) found that 22% of boys and 24% of girls aged between 7-12 years were overweight or obese.[1] The prevalence of overweight and obesity among children from high SES areas in the 2001 survey in the current study were consistent with the HOYVS 1997 estimates in Victoria.[1] In the current study, however, a significantly higher proportion of children from low SES areas were classified as overweight or obese.

In addition to inverse relationships between SES and physical activity,[21] some studies have also suggested inverse relationships between area-level SES and dietary habits among adolescents.[22] Among adults, area-level SES has been found to be inversely associated with BMI, even after adjusting for individual-level SES.[25] It may be that local facilities and opportunities for physical activity and healthy eating are not as readily available or as high quality in low SES areas as they are in high SES areas. A limitation of the current study, however, is that individual-level SES was not collected in the 1985 survey, therefore it was not possible to adjust analyses for individual-level SES in addition to area-level SES. Limitations of using SEIFA to define children's SES are that variables used to derive SEIFA are chosen subjectively, based on experience with earlier indexes. Furthermore, there were some area-level SES sampling differences between the 1985 and 2001 surveys that may partly explain the different cross-sectional relationships found between SES and physical activity and weight status.

Other study limitations include some differences between measures used to assess children's physical activity. In the 1985 survey, children reported their previous week of physical activity and in the 2001 survey children reported their physical activity in a usual week in the current school term. Although the individual items used in the 2001 survey were found to be reasonably reliable when administered on more than one occasion, previous validation of the CLASS physical activity survey[14] showed that children tended to over-report activities that were of moderate intensity (e.g. walking, cycling). If these activities were over-reported, then trends from 1985 to 2001 may be even stronger than the data suggest.

Differences between the surveys may in part be accounted for by seasonal influence. Data collection for the 2001 survey extended into late spring/early summer, eight weeks beyond the data collection in 1985. However, the warmer months are generally associated with increased rather than decreased levels of physical activity among children and adolescents in Australia,[26] suggesting that our findings may even be conservative. The low response rate in 2001 is a further study limitation. It is an ethics requirement in the State of Victoria to gain active informed consent for children's participation in research. Therefore, no information was available regarding the non-respondents. However, if biased inclusion occurred it is likely that the sample would include participants who were more physically active and less likely to be overweight; therefore, the differences identified in this study may be conservative.

This study found significant declines in active transport to and from school, declines in school PE, increases in school sport and increases in overweight and obesity. These trends were stronger among children attending schools in low SES areas compared with those in high SES areas. Persistent increases in overweight and obesity among children in Australia over the last 20 years suggest that changes in energy balance may have occurred through increased energy intake[4] and reduced physical activity. Although there were no rural or regional data available in this study, these are among the first long-term physical activity trend data identified among urban children living in a major capital city in Australia. A better understanding of trends in children's physical activity patterns within different SES areas, of the factors associated with participation, such as perceptions of the neighbourhood and personal safety,[9] and challenges faced by schools within low SES areas to deliver PE and school sport to children will assist with the development of interventions to promote activity during and outside of school hours and thus prevent further physical activity declines.

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